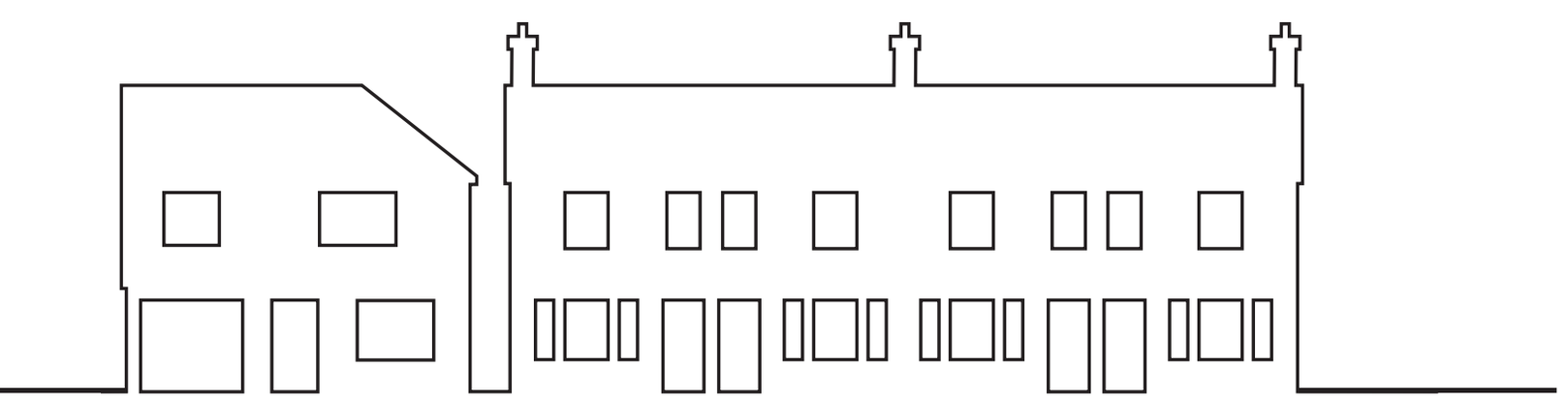
Campaign to Protect
Rural England

Brownfield Market Signals

Greenfield housing land supply and the viability of brownfield housing development



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The following Appendices have been published separately and are available from CPRE's website: www.cpre.org.uk:

Foreword

Brownfield regeneration and the associated transformation of many towns and cities has been one of the great unsung success stories of recent years. Land is now developed more efficiently for housing and last year more than three-quarters of new homes were built on brownfield land, up from just over 50% a decade ago. At its best, this has improved the urban environment, raised standards of design and protected the countryside from unnecessary sprawl.

There is a real danger that shortsighted responses to current economic conditions could undermine urban regeneration schemes in future. This study aims to help avoid such risks. It explores how the economics of developing a particular site, whether greenfield or brownfield, rural or urban, is influenced by the available alternatives. There may be many reasons why suitable brownfield opportunities are not always taken up – sites in complex, multiple ownership; lack of a coherent, long term planning strategy; and, in some cases, the costs of site remediation.

Specifically, this study examines – using econometric modelling techniques – how competing greenfield land supply may be a factor in the viability of brownfield development. It shows how applying market signals through the planning process is more complex and challenging than is sometimes assumed. It demonstrates that understanding how local land markets interact and development sites compete for investment is key to unlocking the potential of brownfield land. These interactions have been assumed, rather than explored, in local, regional and national planning strategies which have provided the foundation for urban renewal over the years. For the first time, this study reveals the nature and potential consequences of 'competing' land supply and how this may affect prospects for brownfield development, and points to a new perspective on the role of market signals in planning.

CPRE recognises the need for more homes. Our recent Vision for the Countryside in 2026 – which will be our centenary year – envisages continuing success with urban regeneration. We foresee over 2 million high-quality homes being created between now and then, mainly on brownfield sites. By continuing to recycle brownfield land and buildings within our villages, towns and cities it is possible to both provide the homes we need and protect the countryside. Tremendous scope remains to make further progress but only if we heed the findings of this research.

Today's challenging economic circumstances have made many development schemes marginal. Planners are under pressure to allocate ever more greenfield land for development to meet housing targets. We need a longer term view which recognises the wider benefits of urban regeneration. Unless we act with vision, we face the prospect of returning to greenfield sprawl and urban decline – which will benefit no one in the long run.

Neil Sinden
Director of Policy and Campaigns, CPRE
June, 2009

Executive Summary

In England there has been substantial change in national planning policy over recent years, with greater market emphasis in setting housing targets since the publication of Kate Barker's *Review of Housing Supply* in 2004. Recent research focuses strongly on the national and regional dimensions of housing supply and affordability. Yet, the impact of planning policy on supply, affordability and the economics of development has received relatively little attention at the level of local housing markets.

This report provides a significant contrast to a series of recent national and regional level housing affordability projects. It focuses on the determinants of housing development viability at the local level and explores how the supply of greenfield land with planning permission for residential development affects the economics of brownfield redevelopment. Such issues reach to the heart of the Government's brownfield land policy, especially to its continued commitment to a 60% national brownfield target and a sequential approach in determining proposals for new housing development and more recently to the encouragement it has given local authorities to adopt more interventionist strategies in pursuit of the brownfield agenda.

The quantitative work reported here draws on datasets that include information on detailed residential planning consents in nine case study local authorities, and digitised local plan data. Data preparation work included significant cross-checking of planning consents against local plan records as well as direct contact with, and advice from, local planning authorities. The research combines these data sources with information obtained from the Department for Communities and Local Government (DCLG), and with robust models estimated in the course of previous research projects (including, for example, a model of new-build house prices).

The research finds that site-specific development viability falls as competition increases – measured in terms of the supply of both planning consents and newly completed homes. At the individual local authority level, the results suggest a more complex picture. Greenfield land supply appears to reduce the viability of brownfield development in some local authorities, but not in others. Our conclusions must be tentative given the pilot nature of this study, but the results suggest that high levels of greenfield supply, particularly in areas of weaker housing demand, reduce the viability of brownfield development. Overall, these results suggest that high levels of housebuilding in one part of a local authority area might well send market signals that make development less viable in other parts of the same authority area. This would point to the need for caution in thinking carefully about the level and timing of planning consents.

These findings point to the need for those engaged with setting targets, planning or delivering new homes to:

- examine the capacity of local housing markets to absorb new supply, both in time and space;
- understand the operation of crucial market signals at the local level; and
- ensure the timing, location and level of consents is informed by an understanding of how local land and housing markets interact.

The findings also highlight the extent to which development viability is place-specific and suggest that the power of local authorities to improve relative viability through active place-making strategies should not be underestimated.

1: *Introduction*

Proposals for new housing development often create intense controversy, both nationally and locally. The planning system seeks to manage this controversy by connecting local decision-making with national policy advice. Since 1998, for example, central government has set a 60% national brownfield target for new housing development in England, but expects local circumstances to determine how exactly this should applied at local level.[1]

In England at least, there has been substantial change in national planning policy over recent years, with an 'economic discourse' accorded greater priority in setting housing targets since the publication of Kate Barker's *Review of Housing Supply* in 2004. Yet, the introduction of market signals into planning thought remains problematic, conceptually, practically and analytically. Over-reliance on market signals at the present time, for example, conceptually might indicate the need to reduce housing land allocations since the recession has caused most housebuilders to restrict their new-build activity.[2] This highlights the different timescales and priorities of the planning system and the housing market.

This report, however, is more concerned with the analytical difficulties that arise in seeking to incorporate market signals into planning decisions and specifically with the danger of adopting too narrow an approach to this.

Specifically, the report provides a significant contrast to much of the macroeconomic modelling work of recent years sponsored by the DCLG and the National Housing and Planning Advice Unit (NHPAU). These models have sought to link house prices, earnings, migration patterns, household formation and employment to land release at the regional level. Yet, whether and when development actually takes place is also an outcome of forces at work in local land and housing markets, about which too little is still known. This emphasises the need for the macroeconomic approach to housing markets taken so far to be balanced by a more microeconomic understanding of how these important local forces interact in practice. The research reported here makes an important contribution in that direction by exploring how the supply of greenfield land with planning permission for residential development affects the economics of brownfield redevelopment.

The research takes an essentially quantitative approach to exploring the dynamics of local land and housing markets. It seeks to build an econometric model of development viability at the site specific level which enables the relationships between greenfield land release and the viability of nearby brownfield redevelopment to be explored in detail. To achieve this, it is first necessary to build contributory models of house prices, construction costs and likely build-out rates. Alongside planning approvals and housing completions data at the local authority level, the model then includes measures of affordability and deprivation to gain a fuller picture of housing demand. It looks explicitly at the physical distance between development sites and their nearest competitors and explores the extent to which competition lessens over distance. Overall, the model has a strong statistical performance, although its results at individual local authority level are more complex.

The work presented here is essentially exploratory and intended to open up a new dimension in looking at the potential contribution of economic analysis within planning decisions. Specifically, it suggests that macroeconomic analysis undertaken at the national and regional levels needs to be balanced by more fine-grained locally-based work to better understand the likely relationship between planning decisions and housing and land markets.

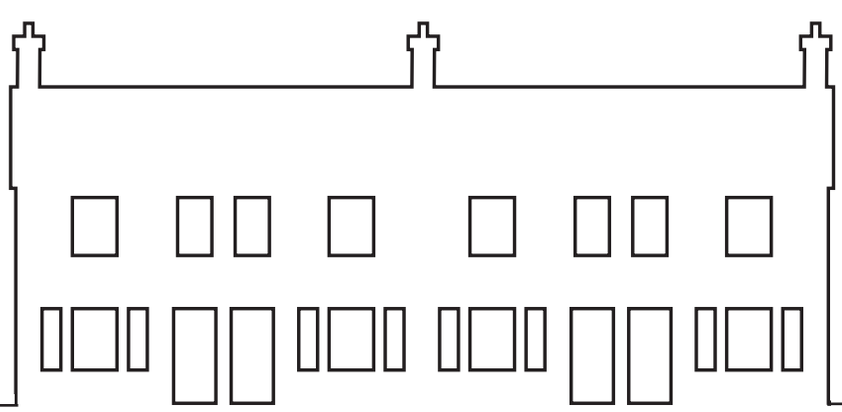
As a pilot study, it was possible to undertake work in only nine local authority areas in England. No claim is made that these nine

1 It should be noted that new homes contributing to the brownfield target can come from both new development on brownfield land and the conversion of existing buildings.

2 It is important to recollect that Kate Barker did not suggest that use of market signals would always result in the allocation of more land for development. Specifically, she pointed out that: 'Prices are not a substitute for planning. However, using them as part of the decision making process can lend itself to better decision making, not just in high demand areas, but also in tackling problems associated with low demand and abandonment. While using prices can allow a better assessment of the costs and benefits of development, there is no presumption that society would then choose to increase the level of development' (Barker, K, Review of Housing Supply – Delivering Stability: Securing out Future Housing Needs, HM Treasury, p. 33, 2004).

areas provide a fully representative sample of English local authorities, but they were chosen carefully to ensure a range of supply and demand conditions and different balances between greenfield and brownfield development. The results are thus presented as tentative, interesting and indicative of the need for more detailed econometric work to be undertaken at the local level.

The next chapter provides a wide-ranging review of the policy context for the research. The research method is set out in Chapter 3, which also explains how the case study areas were chosen. The actual construction of the model is described in Chapter 4, while the results and their implications are considered in Chapters 5 and 6. A summary of the research is presented in Chapter 7.



2: *Policy context for the research*

Introduction

Disputes about the release of land for housing development have proved an inherently controversial feature of the English planning system. For two reasons, no settled consensus has yet emerged, or indeed is ever likely to emerge, around the crucial choices that have to be made about new housing development.

The first reason reflects the acute divergence of interest between relevant stakeholders and especially between those who see the exchange value in land and those who visualise its amenity and broader environmental value, including the sustainability benefits derived from protecting wildlife habitats, areas of ecological importance and scarce natural resources. While the planning system can mediate between these interests on a site by site basis, it never wholly reconciles them. The second reason concerns the ambiguous nature of the planning system itself (at least in the UK), which, while seeking to influence such market outcomes as the location of development, remains heavily reliant on the initiative of market actors for the delivery of important public policy goals such as increased home ownership.

Putting these two reasons together helps explain the inherent 'wickedness' of housing land supply as a policy issue in the sense that policy development has been characterised not by mutual learning and progression towards shared values, but rather by conflict, turbulence and at times, simple re-invention of wheels that have been previously discarded. This is a process that has taken place over at least the past 40 years as respective interests have fought over three main policy questions:

1. *Where the overall supply of development land is regulated by the state, what is the best way to manage and monitor the release of that land?* This question can be traced back to the early 1970s, when worries about perceived shortages of building land began to attract political attention.

2. *What should be the split between greenfield and brownfield development?* This question can be traced back to a broadening interest in the concept of sustainability from the late 1980s.

3. *What are the broader economic effects of state control of land release, and specifically what information on the impact of planning policies on land and housing markets is relevant in deciding future policy directions?* This question is a more recent addition to the debate.[3] Although it began to emerge from the early 1990s, it remained of more peripheral concern to policy-makers until the early years of the 21st century, when the Barker Review (2003 and 2004) placed it at the forefront of policy making.

The purpose of this chapter is to review how the current policy landscape reflects the constant struggle of policy-makers to answer or reconcile these questions. The next three sections of the chapter thus focus on each question in turn. While we acknowledge that the policy drama is played out across the UK under its different devolved administrations, our focus is on England in the period especially since 1997. We seek, in particular, to explain why the third question has emerged strongly in recent years to rival the first two in policy importance. In our account, we argue that the macroeconomic direction from which policy-makers have sought to address this question needs to be matched by more locally-based microeconomic work if a truly productive approach to the economic analysis of planning and development impacts is ever to be achieved.

In the final section of the chapter, we therefore consider how the three questions are inherently linked and why this makes essential detailed analysis of the potential economic

3 While the report of the Urban Task Force, published in 1999, had an implicit concern with the economic prosperity of cities, it did not explicitly address the impact of planning policies on housing markets.

relationship between greenfield land release and brownfield viability, as explored in the remainder of the report.

Managing the supply of land and housing

Despite the introduction of a comprehensive town and country planning system in 1947 and the emergence of Green Belt policy from 1955, a relatively relaxed view of greenfield encroachment was taken during the 1950s and 1960s, especially since the public sector itself promoted both the new towns programme and extensive local authority housing estates at the urban periphery. Concerns about land shortages only began to emerge in the early 1970s, coinciding with the growth of the speculative housebuilding industry, rapid house price inflation and the greater scope for public participation in the planning process. These factors created the potentially explosive political cocktail that all successive governments have sought to manage. The numerous policy reviews and re-interpretations that have taken place over the decades obscure one important fact – that the inherent controversy around housing land supply is not primarily a clash about techniques, but essentially one around values and interests.

So if we wish to explain why particular technical approaches have been preferred in particular policy documents, we need to know which values and interests were in the ascendancy at that time. This will help us understand why the economic discourse has become ever more important in setting housing policy and, as a basis for our own research, identify some of the ways in which its method of analysis remains partial. We shall explore, in turn, the two main components of housing land supply: first, assessing likely housing need and demand and second, managing the release of land to meet that need and demand.

Demographic forecasts of population and household growth have long informed the amount of land allocated by the planning system for new dwellings. It is widely acknowledged that such forecasting is not an exact science and is open to much interpretation, especially around migration assumptions. This has ensured extensive debate, especially at the strategic planning level about the validity of particular demographic forecasts, with development interests often claiming that they underestimate likely growth, and amenity interests the reverse or at least questioning their status in planning policy.

For most of the 1980s and 1990s, the Secretary of State, playing the role of final arbitrator in this process, tended to side more often with development interests and push final housing numbers above (and sometimes significantly above) those proposed by local planning authorities. Two important changes then occurred. Procedurally, the Secretary of State largely withdrew from the role of final arbitrator even for structure plans, allowing more independence for local planning authorities. More significantly perhaps, in 1998, John Prescott (the Secretary of State responsible for planning at the time), signalled an end to the longstanding 'predict and provide' mentality that closely linked demographic forecasting to proposed housing numbers and its replacement by the term 'plan, monitor and manage' in which events on the ground, including the extent of housebuilding actually taking place, would become much more influential in setting future levels of growth.

These policy changes coincided with renewed emphasis on the importance of urban regeneration or urban renaissance, as it was termed by the Urban Task Force (1999), which led to the publication of an Urban White Paper (Department of the Environment, Transport and the Regions [DETR], *Our Towns and Cities: The Future*, 2000a). This emphasised the importance of bringing brownfield land and empty urban property back into use, through tackling vacancy and low demand, assembling land, dealing with contamination,

promoting investment and enterprise and setting sustainable renewal as a new focus for regeneration agencies. Significantly, the Urban White Paper made explicit links between regenerating cities and protecting the countryside, proclaiming that regeneration was 'also vital if we are to relieve the pressure for development in the countryside and preserve the essential qualities of rural communities' (DETR, *Our Towns and Cities: The Future*, 2000a,) and that 'We have also been allowing too many new houses to be built on greenfield sites. This threatens the countryside and fuels the flow of people away from urban centres towards the edge of towns and cities and beyond' (ibid.).

What seemed like an important victory for amenity interests was, however, short-lived. Although the concept of 'plan, monitor and manage' was embodied in the seminal revisions to Planning Policy Guidance note 3: *Housing* published in 2000, within only three years the Government's appointment of the economist, Kate Barker, to conduct a fundamental review of housing supply signalled the resurgence of development interests and their capacity to reframe an apparently technical agenda to their own advantage. Essentially, market signals began to be placed alongside demographic forecasts in determining appropriate levels of housing growth.

Responding to Barker in 2005, the Government thus set a target of 200,000 net additional dwellings each year in England, compared to the then provision of about 150,000 net additional dwellings annually. It was suggested that the higher building target would enable home ownership to reach 75% in England, although this was seen as an aspiration rather than a policy to be achieved by any particular date. Two years later, at the height of the housing boom in mid-2007, the building target was raised to 240,000 net additional dwellings each year in England, intended to produce two million new homes by 2016 and three million by 2020.[4]

While demographic-based planning represented an interventionist approach designed to produce a different set of outcomes from the market, it remained unclear how the incorporation of market signals into local housing forecasts would operate in practice, especially in view of the extent of technical development required to make it possible to combine demographic and market-based forecasts of future housing need and demand. This divergence was illustrated by two housing market scenarios for the 1996-2016 period described by Paul Cheshire (*Oxford Review of Economic Policy*, 2008) one of which was based merely on the projected 4.4 million additional households with the other combining this with a 25% growth in real incomes over the period. Cheshire estimated that, with the same level of housebuilding, the first scenario would produce a 4.4% increase in real house prices across England over the period and the second a 131.9% increase. He concluded:

> *'Thus, in a world in which the supply of land is restricted, the actual driver of real house prices seems to be income, not household numbers, and this stems from the income-elasticity of demand for space.'* (Cheshire, P, Reflections on the nature and policy implications of planning restrictions on housing supply, *Oxford Review of Economic Policy*, 2008)

Whether or not one agrees with this conclusion, the main point is that very few methods yet exist, at least at the local level, to combine demographic and market data in setting planning policy and those which do are not particularly sophisticated. Moreover, in the short to medium term, it is arguable that market-based methods would suggest that less rather than more land might be consumed for new homes, as the housebuilding industry has wound down in response to the recession. Much more work thus will be needed, especially at the microeconomic level, to enable planning authorities to respond sensibly to the desire within the re-cast Planning Policy Statement 3:

4 In October 2008, Margaret Beckett, Minister of State for Housing and Planning, when giving evidence to the House of Commons Communities and Local Government Committee interestingly referred to the figure of two million new homes by 2016 as a 'target' but the figure of three million as only an 'ambition' (House of Commons Communities and Local Government Committee, 2009).

5 Department of the Environment Circular 9/80 introduced the requirement for a five-year land supply and for housing land availability studies undertaken jointly by local authorities and the housebuilding industry. In the absence of a five-year supply, Circular 22/80 introduced 'a presumption in favour of granting planning applications for housing, except where there are clear planning objections.'

6 Successive Secretaries of State have used notification powers, behind which lies the threat to call-in particular types of planning application, to manage the extent to which local authorities in exercising their discretionary planning powers might undermine national policy intentions. Between 1999 and March 2009, local authorities had to notify the Secretary of State of proposals they sought to approve contrary to their statutory development plan, known as 'departure' applications (DETR, Circular 07/99, 1999). In addition from 2000 to 2007 similar notification requirements applied where they sought to approve applications to 150 or more dwellings on greenfield land, or on a greenfield site over 5

Housing for more market-based information to be used in future housing decisions. As we show later in this report, this must include better knowledge of how local land markets actually work.

Over the past three decades managing housing land release has become as important a policy function as forecasting need and demand. The concept of a readily available five-year housing land supply can be traced back to Michael Heseltine's time as Secretary of State for the Environment in the early 1980s.[5] For at least the next decade, housebuilders achieved a privileged position within the policy-making process, with Tom Baron, who had previously run a major housebuilding company, brought in as Heseltine's Special Adviser, and more significantly with local authorities required to work alongside representatives of the housebuilding industry in conducting Joint Housing Land Availability Studies to identify readily-available development land.

By the late 1980s, however, the system had degenerated into one characterised as 'planning by appeal' whereby local authorities clearly unable to demonstrate an effective five-year land supply found Heseltine's successors as Secretary of State regularly ruling in favour of appeals brought by housebuilders. Some balance was restored when the *Planning and Compensation Act 1991* raised the status of development plans in decision-making. This, combined with brownfield targets of 50% from 1995 and 60% from 1998 (see below), reflected the increasing influences of amenity interests during the 1990s and their success in moving the policy agenda much more in the direction of sustainability.[6]

This success perhaps reached its high point with the publication of PPG3 in 2000 in which Urban Capacity Studies finally replaced Housing Land Availability Studies, and a sequential test was introduced allowing local planning authorities to resist greenfield development while suitable brownfield sites remained undeveloped (see box below). Specific allowance could also be made in development plan numbers for likely windfall sites to reflect past and expected trends in brownfield sites coming forward for development that had not been known, or could not be allocated, when the relevant development plan was produced.[7] So, although the requirement for a five-year land

hectares (DETR, Circular 08/00, 2000c). In March 2009 referral requirements were further relaxed. Local planning authorities need no longer notify the Secretary of State of departure applications with the exception of certain categories of development affecting Green Belt, flood risk areas or World Heritage Sites; or entailing the loss of playing fields; or developing town centre uses out of town (DCLG, Circular 02/2009, 2009).

7 Windfall sites 'are those which have not been specifically identified as available in the local plan process. They comprise previously-developed sites that have unexpectedly become available. These could include, for example, large sites resulting from, for example, a factory closure or small sites such as a residential conversion or a new flat over a shop' (DCLG, PPS 3: Housing, p. 19, 2006).

THE SEQUENTIAL APPROACH

Paragraph 32 of PPG3 (2000) stated that 'In determining the order in which sites . . . should be developed, the presumption will be that previously-developed sites (or buildings for re-use or conversion) should be developed before greenfield sites.' Advocates of the sequential test consider that its introduction contributed significantly to the rise in brownfield completions from 2001, as it was felt to provide a clear policy basis for assessing proposals for new residential development. Despite the presumption by many that the sequential test had been abandoned in 2006 with the replacement of PPG3 by PPS3, a recent appeal decision at Stoke-on-Trent makes clear this is not the case. The decision letter turning down the appeal against refusal of planning permission for 36 houses in the Green Belt commented, inter alia, 'the Secretary of State agrees that the proposal would not meet the sequential test set out in PPG3, which was extant at the time of the inquiry and which is not changed in PPS3.' (For details of this appeal, see www.databases.odpm.gov.uk/planning/data/callins/StoneRdTrenthamDL.pdf). Although PPS3 states that 'the priority for development should be previously developed land, in particular vacant and derelict sites and buildings', it limits local planning authorities' ability to phase land release or take into account windfalls to achieve a sequential approach in practice.

supply remained technically in existence after 2000, its context and meaning changed substantially.[8] By 2001, however, the total number of new dwellings completed in England fell to a record postwar low of 129,500, compared with almost 164,000 in 1990. Development interests blamed the planning system for their lack of achievement and, in the post-Barker world, were successful in urging another major policy revision, with the publication of PPS3 in 2006 (DCLG, *Housing Green Paper*, 2006a).

The potential importance of windfall sites is illustrated by experience in the South West and West Midlands. In the South West in 2007/8 55% of new housing development took place on windfall sites – a proportion which in the case of Dorset rose to almost 85% (South West Regional Planning Assembly, *Annual Monitoring Report*, 2008). During the same period in the West Midlands completions on windfall sites amounted to 75% of all completions (*West Midlands Regional Assembly Examination in Public Statement*, paragraph 17, Matter 4A 'Land for Housing', ref 4.A/WMRA/R400, May 2009).

It is possible to argue that PPS3 rewound the clock not simply to 2000, but well before it. Local authorities were required to identify not merely an immediate supply of *deliverable* housing sites[9] for the first five years of a Local Development Framework, but also a further supply of potential development sites for the next five years and indeed, the identification of either more sites or broad locations for growth for the following five years.

Alongside what amounts to a rolling land supply, Urban Capacity Studies were abandoned and Housing Land Availability Studies re-emerged (albeit with broader stakeholder involvement) as Strategic Housing Land Availability Assessments.[10] These were matched by Housing Market Assessments, which were intended to provide local authorities with the necessary market data and information for decision-making, but which were poorly related to specific sites.

The whole essence of PPS3 thus was to set in place a policy-making framework that would enable a substantial rise in housebuilding to take place.

However, it had become apparent that significantly increased output from the housebuilding industry would require the Government not merely to relax its regulatory framework but to take more direct action to boost supply. This realisation had initially been reflected in the Sustainable Communities Plan of 2003, which promised an additional 200,000 new homes on top of those previously planned in four growth areas in the South East of England, at a cost of over £22 billion. Alongside this, action was taken to tackle low demand and abandonment affecting over a million homes in the Midlands and the northern regions, by setting up nine housing market renewal pathfinders.

By 2007, the Government had further committed itself to another 150,000 to 200,000 new homes in the next round of Regional Spatial Strategies (RSSs) (in addition to the 1.6 million included in the RSSs then current), another 150,000 homes to be built through two rounds of the Growth Points initiative and between 25,000 and 100,000 planned further homes in five eco-towns (DCLG, *Housing Green Paper,* 2007a).[11]

Ironically then, in the period immediately before the collapse of the housebuilding industry and towards the end of the longest period of postwar growth in the UK, the Government geared itself up for a further major expansion in housebuilding in the belief that this was essential to meet housing demand. Whether or not it proves to be the case in the long term, the potential short-term availability of significant tracts of greenfield building land during a period of recession, may have a detrimental impact on another Government priority, brownfield redevelopment. We now turn to this issue on which our own work is focused.

8 Paragraph 34 of PPG3 (2002) stated 'Sufficient sites should be shown on the plan's proposals map to accommodate at least the first five years (or the first two phases) of housing development proposed in the plan.'

9 Paragraph 34 of PPS3 (2006) defines deliverable sites as those available now, that offer a suitable development location contributing to the creation of sustainable mixed communities and have a reasonable prospect of development within five years. This is arguably a more demanding definition than that originally associated with the notion of a five-year supply in 1980.

10 Unlike Urban Capacity Studies, Strategic Housing Land Availability Assessments must also look for suitable housing sites 'in rural settlements, brownfield sites outside settlement boundaries and suitable greenfield sites, as well as broad locations' (DCLG, Strategic Housing Land Availability Assessments Practice Guide, paragraph 16, 2007).

11 According to the National Housing and Planning Advice Unit, approved RSSs had, by March 2008, made provision for 210,000 homes to be built annually in England over the period 2007 to 2016 (Williamson, K, Sustainable Development: Affordability Matters, 2008).

Brownfield redevelopment

It is often forgotten that the first brownfield housing target was introduced by John Gummer, the last Conservative Secretary of State for the Environment, who announced in a 1995 Green Paper, that the Government wished to see 50% of all new homes in England built on re-used sites (Department of the Environment, *Our Future Homes*, 1995).[12] Two strands came together to drive this policy change. On the one hand, urban regeneration had become an increasingly important part of Conservative thinking, especially where it was driven by the private sector. On the other hand, the growing influence of sustainability from the late 1980s caused a fundamental review of Government thinking towards the environment, especially after the Rio Summit of 1992, and demanded tangible action across a broad range of policy fields. A brownfield target thus offered a clear opportunity for John Gummer to bring together sustainability and urban regeneration.

What is notable, however, is that similar thinking had begun to emerge from the mid 1980s and specifically in the major review of Green Belt policy that took place at the time (Department of the Environment, *Circular 14/84*, 1984). This crucially added urban regeneration as an important reason for having Green Belts. So, conceptually, by the time the Conservative Government departed office in 1997, the view had been widely established that sustainable urban regeneration could be encouraged by a restrictive approach to peripheral development.

Unfortunately, however, brownfield targets encouraged politicians to think that the mere setting of a target was enough to deliver regeneration on the ground. For as we shall argue, brownfield targets operate primarily as an *economic* device rather than through political dictat and rely on active intervention to help create a flourishing housing market. This is why some consider the extent of greenfield land release in the present recession could potentially undermine brownfield development, irrespective of any particular targets set nationally or locally.

There had been concern that the arrival of a Labour Government in 1997 might have spelt the end for John Gummer's 50% brownfield target. In fact, quite the reverse occurred for, after some initial controversy, John Prescott, the incoming Secretary of State for the Environment, Transport and the Regions, announced in 1998 that a more ambitious commitment would be made. Accordingly, as the revised PPG3 made clear: 'The national target is that by 2008, 60% of additional housing should be provided on previously-developed land and through the conversion of existing buildings' (DETR, *Planning Policy Guidance 3 (revised)*, paragraph 23, 2000b).[13] This national target was to be translated as appropriate to each region and thence on to each local planning area. During this process, John Prescott enthusiastically set out increasing regional brownfield targets (Adams and Watkins, *Greenfields, Brownfields and Housing Development*, 2002) and declaring success as each year's Land Use Change Statistics (LUCS) were published.

Yet, even at this stage, the main drawback of Prescott's brownfield land policy was apparent through a close inspection of the LUCS data in relation to other statistical series published by the same Government department. This arose from the policy focus on the relative proportion of brownfield redevelopment, which created the paradoxical possibility that Ministers could claim success, even if the absolute amount of land recycled fell as a result of reduced overall housebuilding rates. In fact, as Table 1 shows, at 82,899 the *absolute* number of homes built on previously developed land in England in 2001 was hardly any different from the figure of 82,788 for 1993. Absolute brownfield housing numbers are a more challenging and realistic indicator of policy success than relative proportions and have only begun to move significantly upwards from 2002. So what happened then to change real outcomes on the ground? Here, two factors were crucial.

12 The publication of official Land Use Change Statistics (LUCS) from the mid 1980s gave John Gummer the technical basis for his policy and subsequently became ever more influential as an annual series in monitoring brownfield development. Unfortunately, however, the LUCS statistics were misinterpreted by politicians, especially early in the 21st century, to portray the veneer of success, when a more critical evaluation of brownfield policy achievements would have been beneficial (see below).

13 At that time, both CPRE (1997a and b) and the UK Round Table on Sustainable Development (1997) called for a 75% brownfield target. More recently, this call has been echoed by the Sustainable Development Commission (2007).

TABLE 1: TOTAL DWELLINGS BUILT ON PREVIOUSLY DEVELOPED LAND PLUS ESTIMATED CONVERSIONS IN ENGLAND 1985-2008

Year	Land					Dwellings			
	Total hectares of land used for new housing	% of new dwellings built on previously developed land	% of land used for new housing that was previoulsy developed	Total hectares of land used for new housing that was previously developed	Index of land used for new housing that was previously developed	Total new dwellings completed	% of dwellings built on previously developed land plus estimated conversions	Total dwellings built on previously developed land plus estimated conversions	Index of dwellings built on previously developed land plus estimated conversions
1985	8,760		39	3,416	107.8				
1986	7,055		38	2,681	84.6				
1987	7,500		38	2,850	89.9				
1988	7,730	52	41	3,169	100.0				
1989	5,660	52	44	2,470	77.9		55		
1990	7,240	51	45	3,270	103.2	163,899	54	88,505	107.0
1991	4,640	50	45	2,080	65.6	154,595	53	81,935	99.0
1992	5,200	53	47	2,470	77.9	143,831	56	80,545	97.4
1993	5,570	53	48	2,700	85.2	147,835	56	82,788	100.1
1994	6,230	51	46	2,880	90.9	154,641	54	83,506	100.9
1995	5,820	54	48	2,820	89.0	157,141	57	89,570	108.3
1996	5,120	54	48	2,430	76.7	149,086	57	84,979	102.7
1997	5,630	53	47	2,660	83.9	149,493	56	83,716	101.2
1998	5,490	55	48	2,650	83.6	142,651	58	82,738	100.0
1999		56	50			141,040	59	83,214	100.6
2000	5,370	59	52	2,790	88.0	135,130	62	83,781	101.3
2001	5,460	61	55	2,990	94.3	129,530	64	82,899	100.2
2002	5,050	64	57	2,870	90.6	136,820	67	91,669	110.8
2003	5,250	67	58	3,030	95.6	144,040	70	100,828	121.9
2004	3,780	72	62	2,340	73.8	154,110	75	115,583	139.7
2005	4,240	74	63	2,670	84.2	159,480	77	122,800	148.4
2006	4,090	73	64	2,620	82.7	160,870	76	122,261	147.8
2007		73	69			174,550	77	134,404	162.4
2008						141,930			

Source: DCLG, *Land Use Change Statistics for 2007 and Housebuilding Statistics Live Table 217*, 2009

First, the Sustainable Communities Plan of 2003 introduced a more explicitly interventionist approach to brownfield development to replace the previous mere reliance on a target figure. The heart of this new interventionist approach involved 'a new strategic role' for English Partnerships '… to find and assemble land, especially brownfield and publicly owned land, for sustainable development' (Office of the Deputy Prime Minister [ODPM], *Sustainable Communities: Building for the Future,* 40, 2003). Crucially, English Partnerships was charged with developing a comprehensive national strategy

for brownfield land and allocated over £500 million over three years to find and assemble housing sites. Although this was not devoted entirely to brownfield development, it enabled the agency to play a central enabling role in the development of the Thames Gateway, the fourth and largely brownfield growth area identified in the Sustainable Communities Plan. Other actions taken by English Partnerships included recourse to compulsory purchase powers to assemble brownfield land and an explicit programme targeted at the 17,000 hectares of hardcore brownfield land registered on the National Land Use Database, which had remained vacant or derelict since 1993. By 2005, the results of this more interventionist approach to brownfield land were beginning to show, with almost 123,000 dwellings completed on brownfield sites in that year.

Secondly, and as importantly, the rapidly rising housing market in the period up to 2007 made brownfield development increasingly lucrative for the speculative housebuilders, especially in city centres. Although the brownfield development boom was driven forward by the pioneers in the industry, these more specialist companies were in a minority and more than balanced by sceptics who were inherently reluctant to take on brownfield sites (Payne, *The Institutional Capacity of the UK Speculative Housebuilding Industry*, 2009). What made the difference was the middle group of housebuilders, who can be termed pragmatists, whose familiar greenfield markets proved increasingly hard to access as planning restrictions tightened and who saw economic opportunity in switching production to brownfield locations. Crucially then, in a rising market, policy operated not principally by the imposition of targets but by making brownfield development a more attractive business proposition through choking off opportunities elsewhere.

This microeconomic linkage was recognised by both the Urban Task Force (T*owards an Urban Renaissance*, 1999) and in the Sustainable Communities Plan (ODPM, *Sustainable Communities: Building for the Future*, 2003) but primarily in relation to low demand areas:

> '*In the North East and North West, the potential to maximise the re-use of brownfield sites is undermined by the amount of virgin "greenfield" land that planners have already earmarked or released for development*' (Urban Task Force, *Towards an Urban Renaissance,* Executive Summary, p. 15, 1999).

> '*We will review planning policies in the regions affected to ensure that they support the objective of tackling low demand. We have already reduced the amount of urban fringe greenfield housing planned for the North West and North East and set stretching targets for re-using brownfield land*' (ODPM, *Sustainable Communities: Building for the Future*, paragraph 2.17, 2003)

A more positive view of the potential of greenfield restrictions to increase brownfield viability across many parts of the country was taken by both Kate Barker (2003) and John Calcutt (2007) in their respective government reviews on housing supply and the housebuilding industry.

> '*… targets for brownfield build and the sequential test have pushed up demand,* and therefore prices, for brownfield land' (Barker, *Review of Housing Supply – Securing Our Future Needs [Interim Report – Analysis]*, p. 147, 2003)

> '*Additionally, constraining the supply of greenfield land will increase demand for brownfield land. This will increase the price of brownfield land which should consequently promote increased supply as the value of brownfield land for housing comes to exceed its alternative use value*' (Barker, *Review of Housing Supply – Securing Our Future Needs [Interim Report – Analysis]*, p. 147, 2003).

> '*A prudent local planning authority will want to make as much use as possible of brownfield in planning its five-year supply of housing land, as required by PPS3: ideally, meeting or exceeding the Government's 60% target. However . . . sites identified for the five-year supply must be financially viable. There is a risk that any downturn in the market will make the less viable sites altogether unviable, thus increasing the pressure on greenfield land*' (Calcutt, *The Calcutt Review of Housebuilding Delivery*, p. 45, 2007).

Calcutt also expressed a note of caution reflecting early signs of an economic slowdown. His point here is crucial. It is possible to set whatever brownfield target might appeal to ministers, but unless the economic fundamentals are in place, the delivery of that target is likely to prove problematic. As the House of Commons Environmental Audit Committee (*Greener Homes for the Future?* p. 34, 2008) recently commented:

> *'Presented with an excess of available land, it is likely developers will build new developments on greenfield sites in preference to developing brownfield sites within the boundaries of existing settlements. We recommend that Government ensures this does not happen by revising urgently its targets and regional plans in the light of current market conditions, and by reintroducing a clear sequential test in favour of brownfield sites into planning policy.*'

The essential issue, which we explore in this research, is thus whether and how greenfield land release affects brownfield viability at the local level. This points towards a more integrated approach to housing land policy rather than the assumption that a particular brownfield target can be delivered, irrespective of the balance overall between greenfield and brownfield in the local land supply.

In this context, it is noticeable that the re-cast PPS3 published in 2006 retained both the 60% national brownfield target and the requirement for it to be translated at the regional and local levels. More importantly, it urged local authorities to adopt active interventionist strategies, such as land assembly and the release of more public sector land, to help deliver the target at the local level. It remains unclear how far this advice has been heeded or indeed, whether it will remain possible, as public finances deteriorate. It is thus likely that 2009 and 2010 will prove critical years for brownfield policy, with less public sector money to spend on regeneration activities and with private sector incentives to develop on brownfield land reduced by the recession. If this proves to be the case, reliance solely on the 60% brownfield target would be a policy mistake.

Planning and market signals

Since the late 1980s, there has been much academic debate on the economic impact of the planning system (see, for example Cheshire and Sheppard, 1989 and 1996; Evans, 1991; Eve, 1992; Bramley, 1993; Meen and Andrew, 1998 and Monk and Whitehead, 1999). However, until Gordon Brown, when Chancellor of the Exchequer and John Prescott as Deputy Prime Minister jointly appointed Kate Barker in 2003 to undertake a fundamental review of housing supply, this debate had little direct impact on planning policy. While the catalyst for Barker's appointment was the perceived peculiarities of the British housing market which, it was alleged, helped make it difficult for the UK to join the European single currency, the outcome was concerted policy interest in housing affordability, as summarised in the 2007 Housing Green Paper:

> *'House prices have risen more quickly than earnings in all regions. On average, lower quartile house prices are now more than seven times lower quartile earnings. This is not just a problem in the south. Affordability problems in the northern*

> *regions (measured as the ratio of lower quartile house prices to earnings) have risen sharply since 1997. In some areas the ratio has more than doubled. For example in Warrington, affordability has worsened by 140% with the ratio reaching nearly eight times income in 2006.'* (DCLG, paragraph 18, 2007a).

What most sharply divided opinion was Barker's conclusion that the UK's above average house price inflation and worsening affordability could be attributed to a restrictive planning system and hence could be alleviated by significantly greater land releases. It is not the place of this report to review both sides of this argument in detail, but it is worth highlighting the recent work of CPRE (*Planning for Housing Affordability*, 2007) and Paul Cheshire (*Oxford Review of Economic Policy*, 2008) as well-argued contributions to the current controversy on whether, and to what extent, house price inflation would weaken and affordability improve, if much higher levels of housing development were to be permitted.

The Government itself saw strong connectivity between housing growth and affordability, commissioning and publishing a controversial affordability model (ODPM, *Affordability Targets: Implications for Housing Supply*, 2005a) and subsequently establishing the NHPAU which in 2008 produced a much-disputed target range for future housing growth in each English region. Significantly, both were predicated on macroeconomic modelling, which sought to link house prices, earnings, migration patterns, household formation and employment to land release at the regional level. It remained unclear how the results of this regionally-based analysis would connect with the institutional structure and microeconomic construction of local land and housing markets and importantly, whether substantially higher levels of housebuilding, even if achievable, could be reconciled with urban regeneration in general and the 60% brownfield target in particular. Since the affordability model itself recognised that 'The effect of high prices is anyway to stimulate the redevelopment of brownfield sites' (ODPM, *Affordability Targets: Implications for Housing Supply*, 54, 2005a), by implication, it raised the distinct possibility that an enhanced supply of greenfield land at certain locations could render nearby brownfield development less viable.

Barker's call for the planning system to be more responsive to market signals was reflected more strongly in the consultation draft of the new PPS3 published in 2005 (ODPM, *Consultation Paper on a New Planning Policy Statement 3 (PPS3) Housing*, 2005b) than in the final version, which emerged a year later. While the former proposed that speedy take-up of allocated development sites might trigger further immediate releases, the latter contained only a more general expectation for local planning authorities to take market information into account. Moreover, research commissioned by the DCLG (*Planning for Housing: Market Signals*, 2007c) highlighted both the complexity of incorporating market signals within the planning process and the impossibility of finding a relevant common indicator for this purpose. While the research reinforced the policy move towards a broader market assessment, it again emphasised the fine-grained market inter-connections at local level, with the comment that:

> *'Developers may become less able to fund remediation costs from development gain, as accelerated land release leads to an increase in housing delivery, which may cause house prices to fall and lead to lower development gain'* (DCLG, *Planning for Housing: Market Signals*, 4, 2007c).

What has thus begun to emerge from the debate on market signals is the growing awareness that reliance on too simple indicators is likely to be misleading and that policy needs to be based on a more thorough assessment of how land and housing markets operate at the local level. Even if one accepts that there is some linkage between land release and house prices (and that will remain disputed by some), overall regional patterns of

land release may be less influential on market prices and development prospects, than their sub-regional distribution together with specific locations where any land is to be released within a local housing market. Nevertheless, research, and still less policy development, has yet to drill down to this level of detail. This makes the attempt within this report to construct a microeconomic model linking greenfield release and brownfield viability all the more innovative and important. For until we know much more about how a more market-based approach to planning policy will work at the local level, the danger remains that broad policy directions, espoused at the national and regional levels, will have unexpected and undesirable delivery outcomes.

Conclusions

As this chapter has argued, housing land release is an inherently controversial issue, primarily because it is so hard to reconcile the amenity and exchange values of most greenfield development sites. Although comprehensive town and country planning legislation, introduced in 1947, gave the state power to *control* and restrict development, over the past 30 to 40 years governments have become increasingly dependent on the private sector to *initiate* development. That perhaps explains why we can trace more market-orientated forms of planning back at least to the early 1980s, when central government circulars on housing land release once more began to reflect the interests of those in the private sector responsible for housing production. In this sense, increased concern with market signals within planning policy is not an entirely new phenomenon but rather represents the most recent capture of the relevant technical agenda by those who would place exchange value above amenity and broader environmental value.

One of the fundamental reasons why this happened was the focus of brownfield land policy on the relative proportion of new homes built on brownfield land (which was presented as a success by Ministers). This drew attention away from the constant decline in English housebuilding up to 2001 – a decline which contributed significantly to the market problems Kate Barker was called upon to investigate.[14] What Ministers failed to grasp until it was perhaps too late was the enormous challenge involved in switching the attentions of a speculative housebuilding industry, so weaned on building housing estates at peripheral greenfield locations, towards creating sustainable communities at brownfield locations.

As this suggests, if an ambitious brownfield target is to be reconciled with high levels of housebuilding in the medium to long term, it may require more sustained government intervention in urban place-making than recognised so far. Without this, the pursuit of affordability targets through the incorporation of market information into planning decisions, although presented as a technical exercise, is likely to prioritise housing production above urban regeneration and cause downward pressure on brownfield development targets.

The tragedy, of course, would be that failure to fully embrace an urban place-making agenda that might turn towns and cities into the destination of choice for housebuilders and prospective residents alike (rather than a convenient location for excessive high-density apartment building) may necessitate a planning regime in which the only way to deliver required housing numbers is to prioritise market-led development. The current recession, regrettable as it is, thus comes at a critical policy moment for housing land release. Without a real commitment to urban place-making over the medium to long term in which planning authorities take responsibility for development creation rather than mere development control, it is likely that governments wishing to see a substantially greater number of new homes built annually in the UK in future years compared to the years before this recession, will be forced to cede the location of new housing to development interests.[15]

14 Kate Barker was tasked by HM Treasury in 2003 to conduct a review of issues underlying the lack of supply and responsiveness of housing in the UK.

15 At the time of the 2009 Budget, the Government promised to 'report at the 2009 Pre-Budget Report on progress and set out its strategy to support a timely and effective housing supply response through the recovery, in order to maximise delivery of high quality, energy efficient homes, supporting our long term housing supply and environmental objectives' (HM Treasury, Budget 2009, p.105, 2009). This forthcoming strategy may provide an opportune moment to review prospects for achieving the Government's housebuilding plans, alongside broader objectives, such as urban regeneration, in the light of experience since the onset of the credit crunch.

3: *Research method*

Introduction

This project examines the relationship between the supply of greenfield land with planning permission for residential development, and the economics of brownfield residential development. The project therefore addresses important research questions that have arisen during the course of the 'post-Barker' debate. In particular, the project considers the relationship between development viability, at the individual site level, and wider local housing market factors including:

> total land supply;

> the ease and availability of planning permission; and

> the balance between greenfield and previously developed land in the composition of the land supply.

A number of specific research questions can be identified as follows:

> Where brownfield land is in relatively short supply, does this enhance or erode viability?

> Conversely, where brownfield land is in abundant supply does this enhance viability (because housing developers are more specialised and regard this type of site as the norm) or reduce viability (because greenfield alternatives are harder to come by and can generate higher new-build housing prices)?

> Is there a critical mass effect? If the viability of brownfield development is low, at what stage in the land supply balance between greenfield and brownfield sites do the economics of brownfield development become acceptable to housing developers?

These research questions therefore encapsulate a view that the land market, and the forces that combine to determine development viability, are best viewed as dynamic processes. The research approach is designed to consider spatial effects such as the local level of competing supply pertinent to a given site, and temporal effects including the supply of land with planning permission and the rate at which this is absorbed by local markets.

Given the complexity of local housing markets, and considerable variety in terms of overall housing land supply and the greenfield/brownfield balance within this, there is a strong argument that the research questions cannot adequately be addressed using a small-scale, in-depth, qualitative or case-study based approach. A quantitative approach to the research questions carries a number of advantages. In particular, a quantitative approach allows the estimation of key relationships between the economic viability of brownfield and greenfield sites and a range of factors including:

> the quantity of competing sites;

> the levels of house prices, construction costs and interest rates; and

> total land supply.

Given the argument that development sites within a local housing market may effectively compete with each other, a quantitative approach also offers the possibility of estimating whether greenfield competing sites have a different impact on development viability in comparison with brownfield competing sites.

A quantitative approach also has the potential to give insights about general relationships between variables. However, it can offer little insight regarding complex relationships or highly specific circumstances. For these reasons, the methods adopted by this study do not rule out subsequent qualitative or case study based follow-up work. They do offer potential for establishing whether relationships exist, and

offering insight as to potentially fruitful avenues for further, more in-depth research.

Elements of the research method

At the heart of this project is the question of whether the quantity and/or proximity of competing sites impacts on the development viability of sites with planning permission. The final stage in our quantitative approach entails the construction and estimation of a statistical model designed to address this, and related, research questions. However, a number of intervening steps are necessary first. Development viability cannot be observed directly, primarily because housebuilders carry out development appraisal calculations internally, and there is no publicly available source of this information. Viability, following well-rehearsed logic, is a residual of expected housing sales revenue over development costs with an allowance for land acquisition and developer's profit. Logically, viability can be estimated given the means of predicting the housing sales revenue expected from the development of a site combined with a means of predicting associated development costs. Our initial estimation of development viability, on a site by site basis, therefore requires robust models of house prices and of construction costs. These are reviewed, in a conceptual sense, later in this chapter.

The model of development viability

Development viability can be conceptualised as a simple residual valuation calculation in which construction costs are subtracted from the expected revenues generated from the sale of completed housing. Residual valuations are often used by housebuilders and landowners to carry out a basic assessment of either land value, or potential development profit.

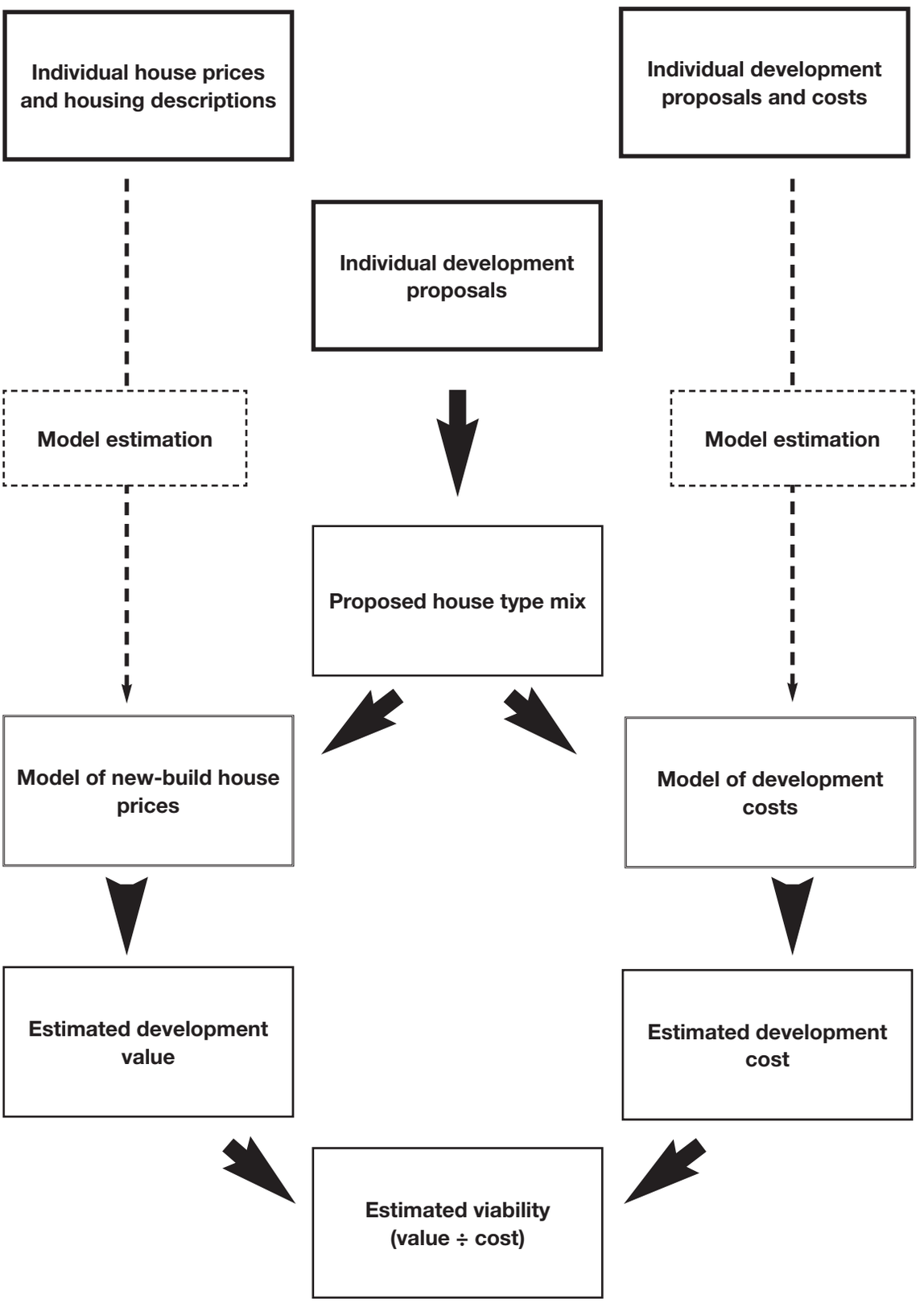
There are some practical difficulties in applying the residual model to form an index of development viability. For example, while there is substantial market evidence on house prices across cities, there is minimal knowledge on intra-urban land plot prices – these data are only available on an aggregated basis, and not at site level. Similarly, there is no reliable source of housebuilders' development profits on a site by site basis. Clearly, aggregated information on profits and costs is available for public limited companies, but this has little value to this research given the impossibility of disaggregating back to site level profits.

It follows that, for the purposes of this research, only two of the important development economics variables can reasonably be estimated: housing sales revenue and construction costs. In order to derive a site-level index of development viability, predicted housing sales revenues are divided by predicted construction costs. This yields an index in which a value of one and below represents an unviable site (because land value and profits would be zero), and higher values represent higher rates of viability. However, it is important to note that this approach allows us to say nothing about any relationship between land value and profit – these are integrated within the index of development viability.

Figure 1 demonstrates the linkages between the house price model, construction cost model and index of viability. The latter is shown at the foot of the diagram. The model of viability focuses on this in particular, and seeks to explain viability with reference to economic, local market and planning factors. This is picked up in detail in the next section.

In summary, the model of development viability is designed to explain estimated, rather than known, levels of development viability. These estimates are formed using as robust a methodology as possible. New-build house prices and construction costs are estimated using well-rehearsed and widely accepted methodologies. They are then combined to provide an index of viability defined as the ratio of expected development value to development costs. The house price and construction cost models giving rise to these estimates of development viability are examined in more detail in the next chapters.

FIGURE 1: CONSTRUCTION OF THE INDEX OF DEVELOPMENT VIABILITY



The house price model

A statistical model of new-build house prices is required in the context of this research for a number of reasons. If we work backwards through the sequence of steps required to build a model of development viability then we can establish the following statistical requirements:

> building a model of viability requires some measure of viability; in other words: an index of the viability of each observation within a sample of housing development sites;

> an index of viability can be formed from the estimated development value and development cost associated with a particular development proposal in a given location; and

> the potential development value of a given site and location can be assembled given information on the type and scale of development and, importantly, a reliable means of predicting housing sale prices.

It follows that building a model of new-build house prices is an important, but transitional step, in the overall research method. In fact, there is extensive housing economics literature that deals with the micro-scale determinants of individual house prices. Much of this literature is built on the idea that house prices can be seen as a function of physical attributes and location, with the impact of these factors changing over time.

Models of house prices constructed according to these assumptions are generally known as hedonic regression models. They follow statistical conventions first laid out formally in a housing market context by Rosen (*Journal of Political Economy*, 1974), but which had previously been applied to the problem of modelling automobile prices in the United States. Hedonic models allow housing to be viewed as a composite good. The logic is that the market price of a house (a composite good) should be derived from the implied market prices of housing attributes (such as bedrooms, living rooms, property design and location, for example). Operationalising such a model requires a dataset which records the transaction price and both physical and location descriptions of a sample of housing transactions. The implied prices of housing and locational attributes are then estimated statistically.

In most examples of published hedonic house price models, the modelling results (and what they imply) are the focus of the work. As mentioned earlier, the requirement for a house price model in this study is much more practical. The value of the model is limited to its ability to assist in answering the following operational research question:

> For a given site that has detailed planning permission for residential development, can we predict the likely sale price of each of the new dwellings proposed?

Provided that the house price model is capable of performing the above, with an acceptable margin of error, our interest in the house price model is complete. When combined with knowledge of the house type mix of a particular development site, the house price model can be used to predict development value (the amount of money that can be generated by selling finished housing units).

The construction cost model

As we noted earlier, an index of development viability may be constructed given knowledge of the development value associated with a particular development proposal, and the likely development cost. It follows that a model of new-build house prices is useful to this research only if accompanied by an independent model capable of predicting development costs. Such a model should be based on our knowledge of the proposed house type mix associated with a given site.

It is well established that housing and flat designs are heavily standardised in the UK. Indeed, Leishman and Warren (*Construction Management and Economics*, 2006) carried out a detailed analysis of the underlying variation in the range of UK housebuilders' standardised housing designs. One of their findings is that the apparently large range of house types offered by housebuilders effectively boils down to a much narrower set of product types defined by property type, size and number of rooms. This heavy standardisation of property types is beneficial from the point of view of this research, as it reinforces the logic of establishing a relatively simple statistical model of residential development costs.

The academic literature on construction economics and cost modelling suggests that project-specific construction costs are likely to be heavily influenced by the size of the development project because economies of scale are thought to be important, and because larger scale projects generally involve longer construction periods and hence greater exposure to economic uncertainties. Regional and local economic factors are also likely to influence costs, primarily because the relative costs and supply of labour and materials vary between local, and particularly regional, construction markets. Macroeconomic variables such as interest rates and inflation are also known to exert an influence over construction costs. The impacts of changes in such variables are likely to vary over time, rather than between different local or regional markets.

Selection of case study areas

As noted earlier in this chapter, development viability may vary depending on the level of land supply in a local housing market in addition to the balance between greenfield and brownfield land supply. Over time, economic variables such as house price levels and interest rates should also have a significant effect on development viability. Within a local housing market area, local factors including neighbourhood quality and the local distribution of household incomes might be expected to exert important influences on the potential viability of housing development sites.

TABLE 2: MATRIX OF CROSS-SECTIONAL SAMPLING REQUIREMENTS

		Brownfield land supply	
		Low	**High**
Greenfield land supply	**Low**		Case study 3: area of more rapidly rising house prices Case study 4: area of less rapidly rising house prices
	High	Case study 1: area of more rapidly rising house prices Case study 2: area of less rapidly rising house prices	Case study 5: area of more rapidly rising house prices Case study 6: area of less rapidly rising house prices

The quantitative approach adopted in this study requires broad representation of a range of housing and land market conditions, in addition to macroeconomic and planning considerations in any sample of data used to estimate the key relationships. For this reason, a group of case study local authority areas is considered in order to ensure representation of high and low greenfield land supply relative to brownfield supply, and a cross-section of housing demand conditions, defined in terms of house price growth. The requirements have been summarised in Table 2 on the previous page:

A preliminary analysis of housing completion totals for the period 2004-2007, and of house price growth rates in the periods 2002-2004 and 2005-2007, suggested the following selection of case study areas:

Case study 1: Corby

Case study 2: Suffolk Coastal

Case study 3: North Tyneside

Case study 4: Southampton

Case study 5: Leeds (or Leicester)

Case study 6: Swindon

Although a primarily quantitative research method underpins this research, the selection of case study areas is not designed to provide a fully representative sample. Instead, areas have been chosen in order to populate the matrix shown above, and to provide a range of housing market and supply circumstances. In addition to the six local authority areas

TABLE 3: SUMMARY OF DEVELOPMENT TYPES RELEVANT TO THIS RESEARCH

Development type	Category
Bungalows	Two bedroom residential development
Bungalows	Three bedroom residential development
Flats	Two bedroom residential development
Flats	Three bedroom residential development
Flats	Four bedroom residential development
Flats	Residential – flats, apartments
Flats	Residential – private development
Flats and housing	Two bedroom residential development
Flats and housing	Three bedroom residential development
Flats and housing	Four bedroom residential development
Flats and housing	Five bedroom residential development
Flats and housing	Residential – flats, apartments
Housing	Two bedroom residential development
Housing	Three bedroom residential development
Housing	Four bedroom residential development
Housing	Five bedroom residential development
Housing	Six bedroom residential development
Housing	Residential – flats, apartments
Housing	Residential – private development

shown above, Eastleigh, Wigan and Leicester were added to the selection in order to improve the geographical representation of the sample of local planning authorities. Appendix 1 contains a detailed description of each case study area.

Description of the data used to estimate the models

The model of development viability is estimated using a dataset drawing on a number of data sources. Information on detailed planning consents was obtained on licence from the Landmark Information Group. This dataset was used to generate information on the size, date and location of detailed residential planning consents in the case study local authority areas for the period 2002-2008.

The planning data contains basic information describing the development proposed for each of the detailed planning consents. Table 3 summarises the combinations of interest of two of these planning data variables – development type and category.

As Table 3 shows, the planning data contains information that is potentially of value in seeking to predict the development value and costs associated with each of the detailed planning consents in the dataset. More detail on the methods used to achieve these objectives is provided in the next chapter.

As might be expected, the number of detailed planning consents observed in each of the case study local authority areas varies considerably. Corby (with 29 brownfield consents) and Leeds (with 930) are the extremes. However, North Tyneside and Eastleigh also have less than 100 during the 2002-2008 study period. There is also considerable variation in terms of the typical size of brownfield developments, defined in terms of number of dwelling units proposed. The median overall is six units, and most of the local authority areas have a similar median. Exceptions are Corby, Swindon and Wigan, with higher medians (14, 11 and 10 respectively). These descriptive statistics are shown in Table 4.

The level of housebuilding activity also varied quite considerably, both over time and between local authority areas, during the study period. This issue is examined in more detail in Appendix 1, which provides a contextual discussion of each of the case study areas. Table 5 summarises annual housing completions, expressed as a rate per 1,000 households in the local authority area.

TABLE 4: SUMMARY OF BROWNFIELD DEVELOPMENT SIZE BY LOCAL AUTHORITY AREA

Local authority	Mean number of units	Median number of units	Number of observations
Corby	46.62	14	29
Eastleigh	17.97	6	96
Leeds	13.32	6	930
Leicester	14.82	7	324
Newcastle	13.22	7	110
North Tyneside	33.76	6	82
Southampton	8.56	5	382
Suffolk Coastal	16.48	6	112
Swindon	34.41	11	136
Wigan	19.09	10	175

Land release: the competition faced by a development site

The research questions, introduced earlier in the chapter, note the possibility that relationships may exist between the viability of development sites, and the quantity and proximity of competing sites. However, testing for such relationships requires significant adaptation of data on detailed planning consents for a number of reasons. Within a given local planning authority, this project considers detailed planning consents granted between 2002 and 2008 inclusive. It follows that:

> not all planning consents within a local planning authority compete with each other: some developments reach completion before developers obtain permission on other sites;

> the intensity of competition is not equal for all development sites: there is variation in terms of size and distance (from a given focus site); and

> significantly for this research, competing sites may be either greenfield or brownfield. The research questions require separate testing of the effects of competing greenfield and brownfield supply on the economics of development.

These facts lead to a requirement for a third form of model, designed to predict the build-out rate of every observable detailed planning permission in our dataset. Such a model can then be used to predict the rate at which the capacity of a competing site reduces, and finally becomes zero (i.e. a completed site). The build-out rate model is discussed in more detail in the next chapter.

TABLE 5: HOUSING COMPLETIONS PER 1,000 HOUSEHOLDS

Local authority	Year						
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Corby	6.57	14.85	13.43	23.57	28.57	40.65	22.51
Eastleigh	3.15	9.81	16.65	12.74	10.08	13.05	11.45
Leeds	6.50	8.19	10.68	8.59	8.92	11.32	8.35
Leicester	3.88	8.93	6.86	5.52	6.72	5.51	3.80
Newcastle	2.70	1.51	2.01	5.06	3.53	3.11	1.81
North Tyneside	1.35	3.90	7.37	7.12	3.09	7.62	1.17
Southampton	6.92	8.33	7.84	8.83	9.14	8.32	5.03
Suffolk Coastal	9.21	10.51	8.80	11.75	12.02	7.39	5.36
Swindon	8.44	11.62	14.13	18.34	19.30	25.96	13.84
Wigan	4.85	6.49	6.91	7.42	9.09	12.65	5.02

4: *Constructing the model of development viability*

Fundamental drivers of development viability

As discussed earlier in the report, the essential research question in this study concerns the potential effects of competing supply of planning consents on the development viability of a site. However, a well designed model of development viability should take into account all logically identifiable drivers of development viability. These include macro-economic influences (particularly interest rates) and the overall level of housing demand. The model therefore includes a number of variables designed to capture these influences.

At national level:

> interest rates.

At local authority level, the following variables are used:

> the overall level of annual new-build housing completions;

> a measure of affordability, as a proxy for the level of housing demand; and

> the supply of land with planning permission.

At neighbourhood level, the following variable is used:

> the Index of Multiple Deprivation (IMD).

The impact of the competing supply of planning permissions on viability

Since the research assumes that the volume, and proximity, of competing planning consents may influence the viability of sites, one or more measures of this form of competition must be constructed at site level. The following variables are constructed on a site by site basis:

> total outstanding greenfield detailed planning consents (number of housing units). Each 'competing' consent, in terms of number of units, is divided by the distance from that site prior to the summing of these 'distance decayed' measures of competing consents; and

> total outstanding brownfield detailed planning consents, divided by distance from that site prior to the summing of these 'distance decayed' measures of competing consents.

The division of number of units by distance is an arbitrary adjustment. There is an extensive literature on spatial interaction modelling (see, for example, Bramley and Leishman, Urban Studies, 2005, and Meen, *Housing Studies*, 1996), and this offers useful insights for this research. A common approach in this literature is to divide variables by squared distance. Economic theory is not able to provide a firm answer to the correct choice of distance decay function. To provide for this, the last two variables described above are recalculated several times using different distance decay functions. This includes:

> dividing the unit capacity of each competing site by distance (d)

> dividing by distance to the power of 1.5 ($d^{1.5}$);

> dividing by distance to the power of 2 (d^2); and

> dividing by distance to the power of 2.5 ($d^{2.5}$).

The different specifications of the variables described above allow greater flexibility in the development of a model of development viability. In particular, the existence of a range of slightly different distance decay functions allows greater flexibility in later model optimisation.

It is important to note that the planning data is therefore used in two different ways in the

construction and estimation of the model of development viability.

(i) The development viability index is estimated for each brownfield site in the sample. The viability model is estimated using this sample of data matched to variables as described below.

(ii) The data is used to construct variables that represent distance-weighted measures of the total level of competing greenfield and brownfield supply. These measures are specific to each site and year of the viability model sample.

The distinction between greenfield and brownfield land was developed using a number of steps since this could not be inferred directly from the site-specific planning data. As an initial step, planning consents were taken to refer to greenfield developments where their location was not within a defined urban area, or where the previous use of the site was described as an urban greenfield activity (such as allotments, playing fields or parks and recreational ground). Where doubt remained regarding the greenfield/brownfield status of sites, assistance was then requested from local planning authorities. Most of the local authorities contacted were able to supply extracts from internal monitoring databases. This information was a valuable means of confirming the greenfield/brownfield status of sites. In some cases, local planning authorities were not able to provide database extracts, but lent considerable assistance by manually working through sites over which queries remained.

A build rate model is an important step in the process of converting information on detailed planning consents to a measure of competing supply. To illustrate, consider a hypothetical situation in which we wish to construct a measure of the total level of competing nearby land supply with planning permission for a site (figure 2). Suppose that:

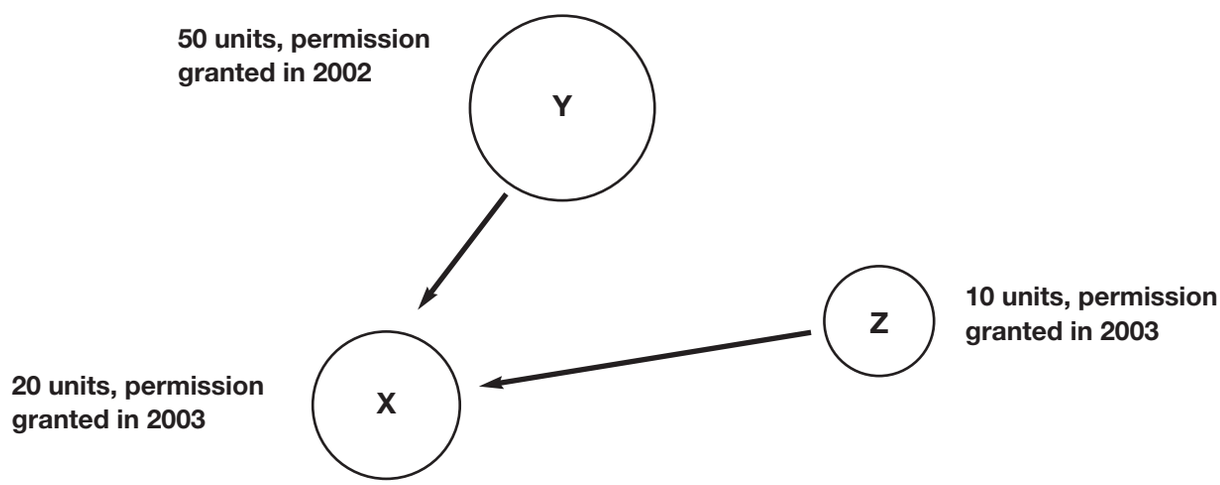
> site X (for which we wish to calculate the measure) is a site with detailed planning permission for 20 units granted in 2003;

> Y is a site with detailed planning permission for 50 units granted in 2002;

> Y is 2 kilometres distant from X;

> Z is a site with detailed planning permission for 10 units granted in 2003; and

FIGURE 2: THE CONCEPT OF COMPETING SUPPLY VARIABLES



> Z is 3 kilometres distant from X.

In seeking to devise a measure of the competing supply of outstanding planning permissions, the question is whether Y and/or Z should enter the calculation. Z is a simple case. Given that this site received planning permission in the same year as site X, we can simply divide 10 (units) by 3 (kilometres) and add this to the running total of the new competing supply variable.

Site Y is a different case. It received planning permission a year earlier. Whether this site should enter the calculation depends on its status in 2003 (when site X receives permission). If site Y is fully developed, with all housing units sold, then this site does not represent competing supply with respect to site X. So, site Y should not enter the calculation.

However, if 20 units on site Y are completed in 2002, then site Y represents a remaining capacity of 30 units in 2003 – when site X receives planning permission. The running total of the new competing supply variable should be increased by 30 (units) divided by 2 (kilometres) to reflect this.

Therefore, to return to the point made on page 26, a build rate model is needed in order to estimate the rate at which sites with detailed planning permission are developed. In effect, such a model then distributes the capacity of a site with newly acquired planning permission across the year in which planning permission is received, and subsequent years.

The build-rate model

The statistical results for the build rate model estimation are shown in Appendix 2. The model is a simple one, and draws on a larger dataset of detailed planning consents spanning the period 2002-2008. The dataset, sourced from Emap-Glenigan, covers every local authority in England. The analysis is based on the dates on which planning permissions were granted together with project start and completion dates and construction contract values as stated in planning applications.

The results of the build rate model suggest that:

> development size increases the length of development period;

> flats increase the length of development period at a slightly lower rate than houses (0.059 months per unit compared with 0.061 months per unit);

> a development comprising only flats has a shorter development period (by around one month) than developments with some housing component in addition to flats; and

> there is a very small, but statistically significant, economies of scale effect. The rate at which development times increase with respect to the number of units drops as development size rises. In other words, the 0.059 months per flat and 0.061 months per house begin to reduce as developments become larger.

Further analysis of the Emap-Glenigan dataset reveals that the median delay between the granting of detailed planning permission and the commencement of development is eight months (mean 10.06).

The combined information on delay between planning consent and start, and on the length of time required to develop a site with a given number of units of housing or flats, allows the estimation of total development period for each site in the ABI dataset. Table 6 summarises the predictions of the build rate model for several hypothetical development types.

TABLE 6: PREDICTED DEVELOPMENT PERIODS FOR HYPOTHETICAL SITES

Development type	Delay before start (months)	Development period (months)
10 flats	8	8.72
40 flats	8	10.45
10 houses	8	9.75
40 houses	8	11.54
20 flats, 20 houses	8	11.50
150 houses	8	17.60

The predictions shown in Table 6 clearly reveal the differences between expected build rates of flatted and housing developments, and between smaller and larger developments. For example, a small development of 10 units is expected to reach completion around 16.72 months after planning consent in the case of a development of flats, or 17.75 months for a housing development. This demonstrates how these predictions translate to site level annual completions. The rate at which the expected development period increases, falls with a growth in development size. So moving from a 10 unit housing site to a 40 unit site, followed by a 150 unit site would suggest development period rising from 17.75 months to 19.54, to 25.60 months – a clearly smaller than proportionate rise.

Construction of the competing supply variables

As noted earlier, the build rate model is required in order to distribute housing completions at site level over time. This is necessary to say how much a given site adds to the level of competing outstanding planning consents at a given point in time and at a given distance from every other site. Table 7 translates the predictions of the build rate model into this basis for the same hypothetical development types.

The predictions suggest that even relatively small sites of around ten units are likely to represent some level of competition to other potential development sites for some time. If year 1 represents the year in which detailed planning permission is granted, then a ten unit flatted site should represent competing

TABLE 7: PREDICTED SITE LEVEL COMPLETIONS FOR HYPOTHETICAL DEVELOPMENTS

Development type	Completions in year 1	Completions in year 2	Completions in year 3
10 flats	5	5	0
40 flats	15	25	0
10 houses	4	6	0
40 houses	14	26	0
20 flats, 20 houses	14	26	0
150 houses	34	102	14

TABLE 8: DIMINISHING CAPACITY OF A 40 UNIT HOUSING SITE

Month	(A) Remaining capacity	Calendar month and year
1	40.00	July 2003
2	40.00	August 2003
3	40.00	September 2003
4	40.00	October 2003
5	40.00	November 2003
6	40.00	December 2003
7	40.00	January 2004
8	40.00	February 2004
9	36.53	March 2004
10	33.07	April 2004
11	29.60	May 2004
12	26.14	June 2004
13	22.67	July 2004
14	19.20	August 2004
15	15.74	September 2004
16	12.27	October 2004
17	8.80	November 2004
18	5.34	December 2004
19	1.87	January 2005
20	0	February 2005

supply of ten units for most of that year, and a competing supply of five units for the early part of the following year. Meanwhile, a larger site with a capacity of 150 units should still represent significant competition a full year after the grant of planning permission, and a small amount of competition after two years.

The build rate model is used to predict the level of competition represented for each site with detailed planning consent in every month of the study period 2002-2008. Final construction of the competing supply variables is then undertaken by averaging that level of competing supply for a given calendar year. For example, a site with planning permission for 40 units of housing would have a development period of 11.54 months following a post-planning delay of eight months, as shown in Table 6. If a particular site received planning permission in July 2003, then the diminishing level of competition on a monthly basis is as shown in column (A) of Table 8.

Results of the new-build house price and construction cost models

Appendices 3 and 4 set out the statistical results relating to the new-build house price and construction cost models. As discussed earlier in this chapter, predictions from these models are used to estimate gross development value and gross development costs on a site by site basis. These estimates are then combined to form an index of development viability.

The spatial patterns of greenfield competing supply, and predicted brownfield viability, are shown for the case of Corby in Figures 3a and 3b.

FIGURE 3A: THE SPATIAL PATTERN OF GREENFIELD COMPETING SUPPLY IN CORBY

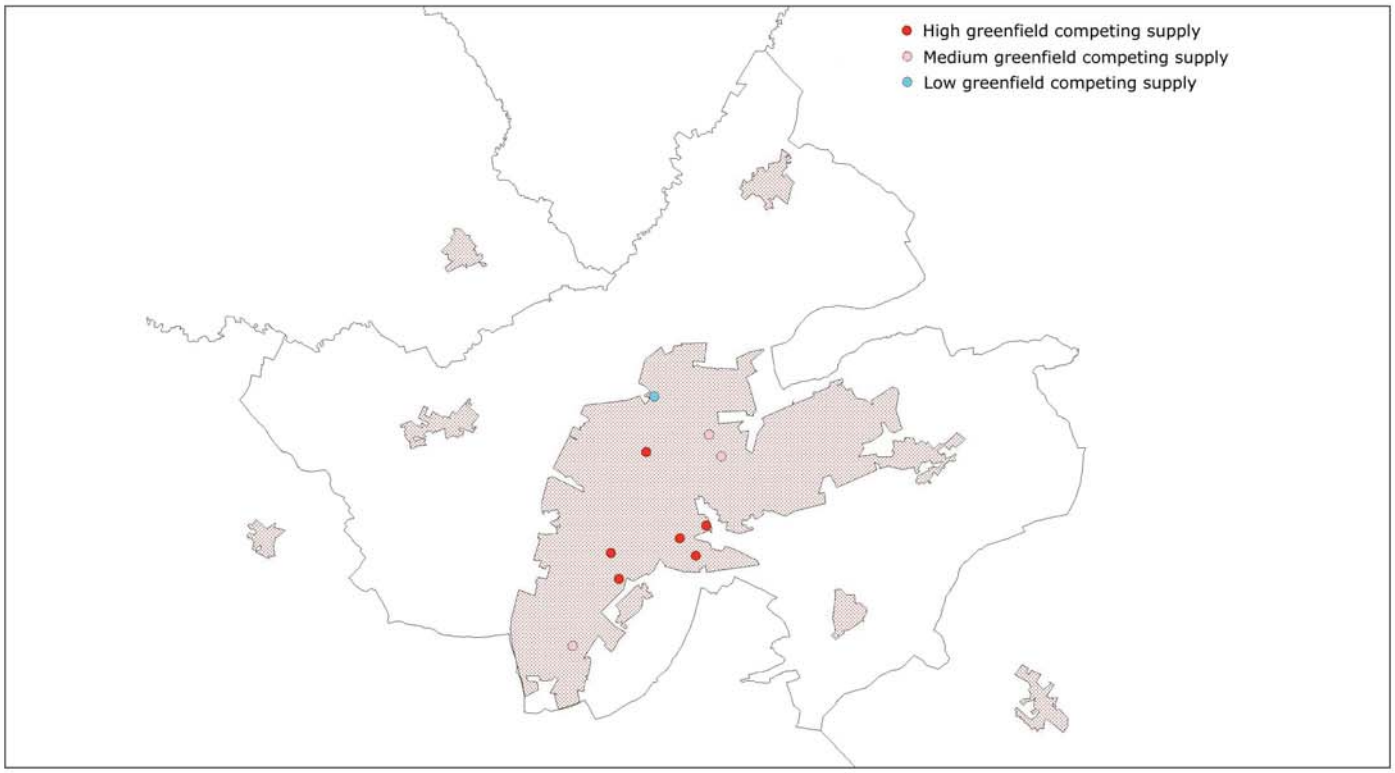
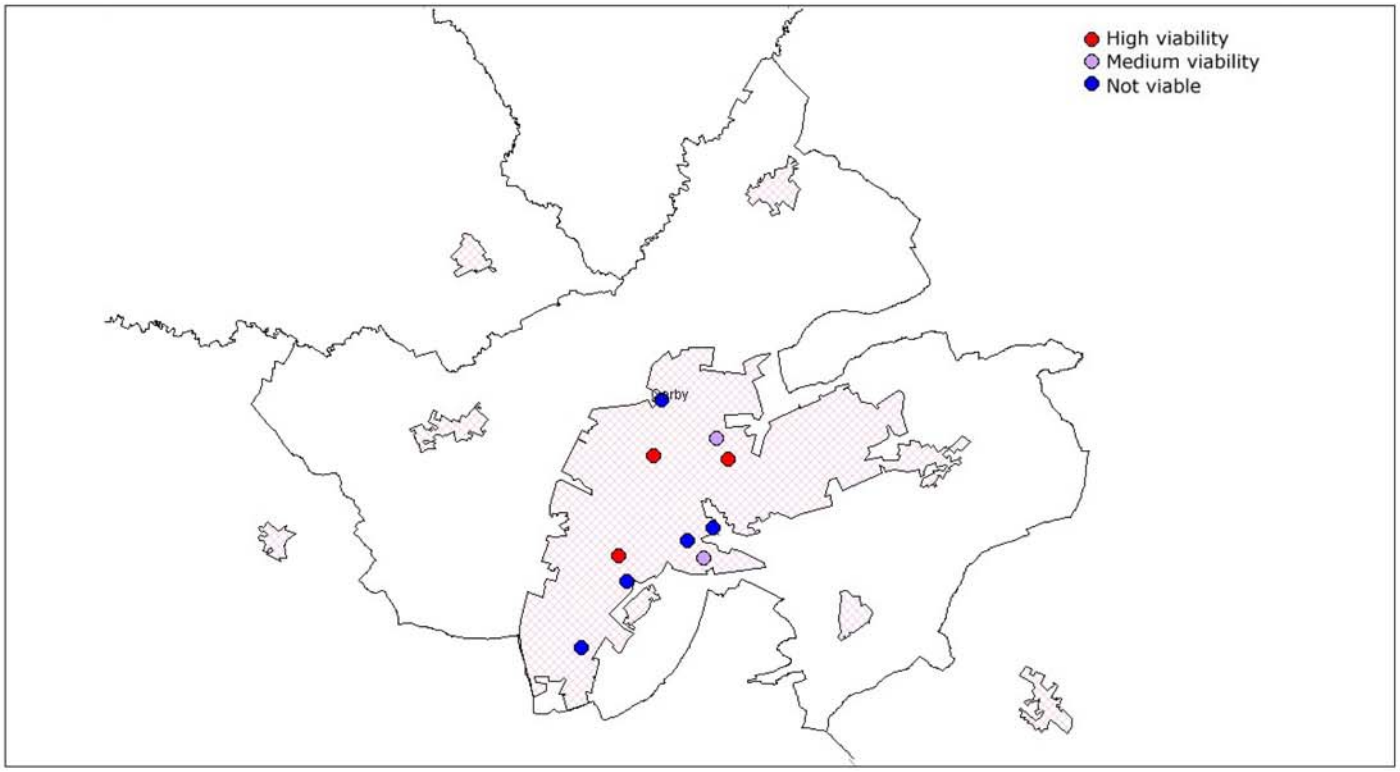


FIGURE 3B: THE SPATIAL PATTERN OF PREDICTED BROWNFIELD VIABILITY IN CORBY



5: *The model of development viability – estimation results*

The results of the model estimation are shown in Table 9. As discussed earlier, the model of development viability includes a range of variables measured at local authority level. These include annual housing completions, the lower quartile house price to household earnings level and the annual level of housing land supply (outstanding planning consents in number of units). Interest rates are clearly measured at national level, so the model assumes that this variable impacts on development viability equally, irrespective of location. Appendix 5 demonstrates how the model results can be combined with variable values in order to predict development viability.

The variables measuring competing supply are constructed in the same way for each local authority area, but are entered into the model separately for every local authority area. This has the benefit of permitting the relationship between competing supply and viability to differ between local authority areas.

Overall, the model has a strong statistical performance. The adjusted R square is 0.64, which means that the model explains 64% of variation in site level estimates of development viability. Variables measured at national and local authority level are statistically significant and are correctly signed.[16] For example, the level of housing completions and total outstanding planning consents are negatively signed. This means that, as the level of these variables increases, site level development viability decreases. The lower quartile house price to household earnings variable is significant and positively signed. This suggests that the viability of brownfield housing developments increases as affordability decreases which is in keeping with prior expectations. Development viability decreases as interest rates rise. In theory, interest rates should act to constrain viability in two different ways: (i) households primarily purchase housing using mortgage finance, and higher interest rate levels consequently imply higher relative housing costs; and (ii) housebuilders are required to finance site acquisition and construction costs in advance of housing sale receipts. As interest rates rise, all other factors being equal, the viability of development should fall.

Site level development viability decreases as the IMD score rises. Once again, this is in keeping with prior expectations as the level of like-for-like new-build house prices varies considerably within a local authority area. Experimentation with the various sub domains of the IMD did not lead to stronger empirical results, so the final form of the model includes only the composite IMD score as shown in Table 9.

The results for the local authority specific competing supply variables are rather more complex and require some detailed explanation. The normal convention of including only statistically significant variables was followed in deriving the final model shown in Table 9. Therefore, the non-appearance of local authority competing supply variables in Table 9 shows that no statistically significant relationship could be found between levels of competing supply and development viability in those local authority areas.[17]

The impact of competing greenfield supply

In Corby and North Tyneside local authority areas, the level of nearby competing greenfield outstanding planning consents has a statistically significant negative effect on brownfield site viability. In North Tyneside, competing brownfield supply also has a statistically significant negative effect, but this effect is much smaller compared with the greenfield competing supply effect.

In the Suffolk Coastal and Swindon local authority areas, proximity of competing greenfield outstanding consents appears to

16 For example, higher interest rates should reduce viability, so we would expect this variable to have a negative coefficient. If the estimation yields a negative coefficient, we can regard this as correctly signed.

17 For example, in the case of Corby the sum of brownfield supply divided by distance was not statistically significant and therefore not entered into the final model.

TABLE 9: MODEL OF DEVELOPMENT VIABILITY – ESTIMATION RESULTS

Variable	Coefficient	T[a] statistic	
Constant	0.6355	9.469	***
Private completions per 1,000 households	-0.0074	-1.988	**
Lower quartile house prices to earnings	0.0597	6.044	***
Interest rates	-0.2889	-17.006	***
Total outstanding planning consents per 1,000 households	-0.012	-5.104	***
Units	0.0417	42.865	***
Units^2	-0.0002	-26.167	***
IMD	-0.0041	-6.274	***
Corby sum of greenfield supply ÷ distance	-5.9354	-3.152	***
North Tyneside sum of greenfield supply ÷ distance	-2.9312	-4.529	***
Suffolk Coastal sum of greenfield supply ÷ distance	3.4366	4.6645	***
Swindon sum of greenfield supply ÷ distance	0.8494	2.901	***
Eastleigh sum of brownfield supply ÷ distance$^{2.5}$	0.0068	1.939	*
North Tyneside sum of brownfield supply ÷ distance	-0.3894	-2.736	***
Southampton sum of brownfield supply ÷ distance^2	0.0109	2.204	**
Suffolk Coastal sum of brownfield supply ÷ distance	-0.5008	-3.721	***
Wigan sum of brownfield supply ÷ distance	-0.2569	-4.114	***
Adjusted R square[b]	0.6365		
Standard Error[c]	0.387		
F statistic[d]	188.929		
Number of observations	1,717		

Note: *** denotes statistically significant at the 1% level; ** at the 5% level; and * at the 10% level

a *T statistic – this is a parametric test statistic whose value implies a level of statistical significance. The level of significance is normally looked up in statistical tables, but a rough rule of thumb is that t statistics of below -2 or above 2 suggest significance with 95% confidence.*

b *R square – an adjusted measure of the proportion of variance in the data explained by the model*

c *Standard errors – the estimated standard deviation of a population. The standard deviation can be measured from a sample of data, but the standard error must be estimated.*

d *F statistic – this tests the notion that all parameters in a model are jointly equal to zero and that the model therefore has no explanatory power.*

increase the viability of housing development. In the case of Suffolk Coastal, this is a pronounced effect. In the case of Swindon, the magnitude of the effect is much less, though it is still statistically significant.

The impact of competing brownfield supply on the viability of brownfield development also differs between the case study local authority areas. In North Tyneside, Suffolk Coastal and Wigan, there is a negative effect, suggesting that a high supply of brownfield consents acts to reduce the viability of brownfield developments. In Eastleigh and Southampton, there is a very small, but positive effect. This suggests that brownfield developments may benefit (in terms of viability) from the proximity of other brownfield planning consents.

Summary

The research has examined, in some considerable detail, the empirical steps taken to construct variables necessary for testing the research question: Does proximity, or level, of competing supply impact on the economics of brownfield development?

The final model – the model of development viability, is estimated after traversing a number of complicated data transformation and estimation steps. Site level viability is proxied using models of new-build house prices and of housing construction costs. Measures of competing supply are constructed using data on detailed planning consents as a base, and a site level model of build rates as a means of distributing competing supply over time on a site by site basis.

The statistical results for the estimated model of development viability show that a robust and credible model of viability can be estimated with reference to macro, local and site level supply and demand variables. All of the signs of the variables included in the model are correct, and a number of the measures of competing supply are statistically significant.

The modelling results show a combination of clear and unexpected results. A strong relationship appears to exist between development viability and levels of competing supply in some local authority areas. In others, there appears to be no relationship, or an unexpected one. The potential reasons for this variety in the modelling results are examined in more detail in the next chapter.

6: *Discussion of the modelling results*

The limitations of the research methods and results

It is important to recognise the limitations, as well as the strengths, of the choice of research method. Earlier in the report it was noted that quantitative approaches offer the potential for uncovering complex relationships, and the reinforcement of insights using the results of widely accepted modelling approaches and statistical testing. However, quantitative approaches do not lend themselves to the generation of considerable detail or finely-grained information about specific case studies or development sites.

The case study areas chosen for the purposes of this study were designed to represent a range of housing and land market circumstances but, as noted earlier, the study is not designed to be a representative one. This would require a more substantial sample of local authority areas.

The study period, 2002-2008, was chosen partly because it takes in an era of significant change both in terms of planning policy, and in terms of house price growth and development activity. In part, the choice of study period also reflects pragmatic factors because prior to 2002, the quality and availability of digitised planning information diminishes significantly.

It is important to note that the local authority areas examined in this study will have been home to sites with detailed planning permission granted before the beginning of the study period. In some cases, these sites will have been fully developed before, or early in, the 2002-2008 study period. In other cases, these prior detailed planning permissions will have remained either fully outstanding, or as partially completed developments, in the early years of the study period. For this reason, the measures of competing supply devised for the purpose of the modelling work in this study should, by definition, better reflect the reality of competing supply later rather than earlier in the study period.

Despite this potential limitation, extensive experimentation with time-varying effects, and even use of simplistic 'time dummy' variables did not lead to stronger empirical performance of the development viability model. Nevertheless, the fact remains that the measures of competing supply almost certainly under-count during the early part of the study period. This strongly suggests that,

TABLE 10: DESCRIPTIVE STATISTICS FOR THE COMPETING SUPPLY VARIABLES

Local authority	Greenfield		Brownfield	
	Mean	Median	Mean	Median
Corby	0.051	0.051	0.042	0.047
Eastleigh	0.032	0.005	3.891	0.111
Leeds	0.046	0.036	1.139	0.679
Leicester	0.018	0.012	1.226	0.862
North Tyneside	0.058	0.036	0.177	0.124
Southampton	0.002	0.001	0.723	0.446
Suffolk Coastal	0.030	0.008	0.165	0.066
Swindon	0.158	0.140	0.602	0.346
Wigan	0.031	0.020	0.290	0.199

where significant relationships were uncovered between competing supply and development viability, these will be under-estimates.

Interpreting the results

No relationship between competing supply and development viability was detected in a number of the case study local authorities. This does not necessarily mean that such relationships do not exist in these local authority areas – it may also reflect the very low level of greenfield supply in some of these areas. To illustrate, Table 10 summarises the greenfield and brownfield competing supply variables for each of the case study areas. The competing supply variables are described in Chapter 4 (see pp 28 and 29 especially) – they represent a site level index of competing supply. The variables put less weight on distant sites than nearby ones because site capacities are divided by squared distance. The figures in Table 10 represent local authority means and medians of these variables or indexes.

An analysis of Table 10 reveals the following:

> Swindon has the highest level of competing greenfield supply, followed by North Tyneside and Corby;

> brownfield sites in Leicester and Southampton have very low levels of greenfield competition, as defined in this study;

> Eastleigh has a very high level of competing brownfield supply, followed by Leicester and Leeds; and

> Corby, North Tyneside and Suffolk Coastal have very low levels of brownfield competition, as defined in this study.

If we express competing greenfield supply as a proportion of competing brownfield supply, a slightly different pictures emerges, as shown in Table 11.

The four local authorities associated with a significant relationship between greenfield competing supply and brownfield viability also stand out in Table 11. These local authority areas have among the highest ratios of competing greenfield to brownfield competition. This helps to explain why no relationship was found in Eastleigh, Leeds, Leicester, Southampton or Wigan. Of course, there should be no presumption that such a relationship would not become evident should these local authorities release substantial quantities of greenfield land in the future. However, the figures in Table 11 do not demonstrate an obvious reason for the finding

TABLE 11: THE LEVEL OF COMPETING GREENFIELD RELATIVE TO BROWNFIELD SUPPLY

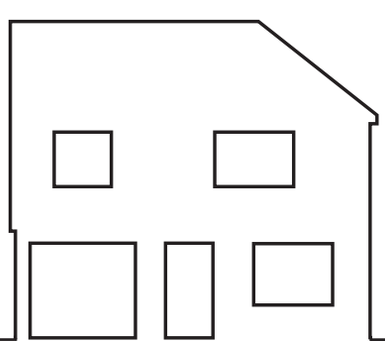
Local authority	Median greenfield ÷ median brownfield competing supply
Corby	1.085
Swindon	0.405
North Tyneside	0.290
Suffolk Coastal	0.121
Wigan	0.101
Leeds	0.053
Eastleigh	0.045
Leicester	0.014
Southampton	0.002

of positive effects in two local authorities (Swindon and Suffolk Coastal) and negative effects in two (Corby and North Tyneside).

A further limitation of the modelling approach is inherent in the choice of a relatively small number of case study local authorities. Site level planning data were collected for the 9 case study local authorities, but not for local authorities beyond the study area boundaries. This means, for example, that competing planning consents in adjacent local authorities are not represented in the competing supply variables. The latter are constructed on an individual local authority basis, with no cross-boundary element. This problem is likely to affect some local authorities differently to others. For example, the viability of sites in North Tyneside may logically be affected by the availability of sites with planning permission in Newcastle upon Tyne. Equally, strong interactions may be expected between Eastleigh and Southampton.

In Suffolk Coastal, there is evidence of significant greenfield land releases in adjacent local authority areas in the study period in the southern part of the district close to Ipswich. However, the impact of these on the viability of brownfield development in Suffolk Coastal cannot be estimated given the approach adopted to construct measures of competing supply in this study. It is also possible that the particular urban form of Swindon, with the dominant influence of postwar development and the scattered supply of urban brownfield sites,[18] helps create a positive relationship between greenfield development and brownfield land values, especially if major greenfield releases produce major retail, leisure, educational, health and associated investment to the benefit of nearby brownfield sites.

18 The scattered supply of brownfield sites in Swindon may be associated with the loss of former employment sites close to the centre of the town and their replacement by greenfield employment land on the periphery, thus indicating a more indirect effect between brownfield and greenfield forms of development.



7: *Conclusion*

This report has presented the first detailed analysis of how the supply of greenfield land with planning permission for residential development might affect the economics of brownfield redevelopment. As indicated in our policy review, the balance between brownfield and greenfield development has been an important policy concern for nearly two decades, with much speculation accorded to the likely relationship between them. It is perhaps therefore surprising that recent econometric research has concentrated on the national and regional levels and has not drilled down to investigate the economic forces at work at the local level. Although a pilot study with tentative conclusions, we believe that the econometric model of development viability at the site specific level presented here opens up a new dimension in this important debate and points to the need for much fuller analysis of the operation of local land and housing markets.

Overall results

At the overall level, the model has strong statistical performance, explaining 64% of variation (an adjusted R square of 0.64). Variables nationally and across all nine local authority areas are statistically significant and correctly signed. In other words, as one might expect, the model suggests that brownfield sites become more viable as interest rates fall and in locations that are more prosperous with less deprivation. In this sense, brownfield development can be regarded as a business opportunity as much as a policy target and one whose viability is dependent on a broader range of economic and political variables, rather than simply land allocations.

Crucially, across the model as a whole, site-specific viability falls as competition increases – measured in terms of the supply of both planning consents and newly completed homes. These are important findings since they both emphasise the need to think carefully about the capacity of local housing markets to absorb new supply, both in time and space, and challenge prevailing thought which pays insufficient attention to the operation of such market signals at the local level.

Findings at the local level

At the individual local authority level, a more complex picture emerged. No relationship was found between greenfield supply and brownfield viability in Eastleigh, Leeds, Leicester, Southampton or Wigan, probably because competing brownfield supply in each of the areas far outweighed competing greenfield supply.

In Suffolk Coastal and Swindon, increased greenfield supply appeared to make brownfield development more viable, with a pronounced effect seen in Suffolk Coastal and a smaller but still statistically significant effect evident in Swindon. We are not sure why this is the case or whether it is due to special geographical circumstances in the case of Suffolk Coastal (notably, the strong impact of the Ipswich housing market just across the border) or special historical circumstances in the case of Swindon (significant postwar expansion of a Victorian railway town where more recent large-scale greenfield development may have the potential to enable settlement-wide improvements in the level and quality of local services and facilities). As previously intimated, the results for Suffolk Coastal may be distorted by the closeness of the major Ipswich housing market just across the border to the south and the large scale greenfield allocations that have been made within Suffolk Coastal primarily to serve that market. We have checked for the possibility of a similar effect in the north part of Suffolk Coastal in relation to the Lowestoft housing market, about ten miles to the north of the district boundary, but can find no evidence of

this, especially since greenfield release in Suffolk Coastal has been concentrated in the south, not the north of the district.

In North Tyneside and Corby, however, we found that the extent of competing greenfield development had a statistically significant negative effect on brownfield site viability. In North Tyneside, we also found a statistically significant negative effect from competing brownfield development which, although much smaller than the greenfield effect, further emphasises the need to think carefully about the absorptive capacity of local housing markets. A similar negative impact of competing brownfield supply was also observed in Suffolk Coastal and Wigan, although the reverse picture was evident in Eastleigh and Southampton, where competing brownfield development had a very small, but positive effect impact on viability.

There are, of course, limitations with this pilot study, especially since it was restricted to nine local authority areas over the period 2002-08. It was not possible, for example, to gain a fully accurate picture of the extent of outstanding planning approvals going into the period, although after testing alternative modelling strategies, we do not believe this significantly affected the results. More importantly perhaps, since we wished to explore relationships in different parts of England, we looked individually at nine separate local authorities. There would indeed be a case for now looking at a series of adjoining local authority areas and exploring how planning consents in one might affect viability in the others.

A new approach to market signals

Nevertheless, the research results, especially in North Tyneside and Corby, begin to suggest statistically that high levels of housebuilding in one part of a local authority area might well send market signals that make development less viable in other parts of the same authority area. This would point to the need for caution in thinking carefully about the level *and timing* of planning consents, especially in parts of the country that are not necessarily the strongest in market terms. From a research perspective, it suggests that local market analysis can make an important contribution to the current debate and that it is unproductive to limit economic analysis of the relationship between planning policy and housing markets to the national and regional levels alone. More importantly, perhaps from a policy and practice perspective, these findings indicate that there are more dimensions to the market signals perspective than currently acknowledged, that they are potentially more complex than previously thought and that they do not necessarily all point in the same direction.

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June 2009

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Appendices to the Report:
Brownfield Market Signals

Appendix 1: The Case Study Locations[1]

Corby

Corby was transformed from a small Northamptonshire village into an industrial town by the arrival of steel-making in the mid 1930s. It expanded further from the 1950s onwards following designation as a new town. After the steelworks closed in the 1980s, redevelopment was assisted by Enterprise Zone status, which attracted more varied inward investment. Essentially, still a Midlands manufacturing town even at the turn of the 21st century, Corby has since embarked on a radical change of direction. Along with its immediate neighbours, it now constitutes the North Northamptonshire growth area[2]. This is itself the northernmost tip of the broader Milton Keynes and South Midlands growth area, identified in the *Sustainable Communities Plan* (Office of the Deputy Prime Minister, 2003).

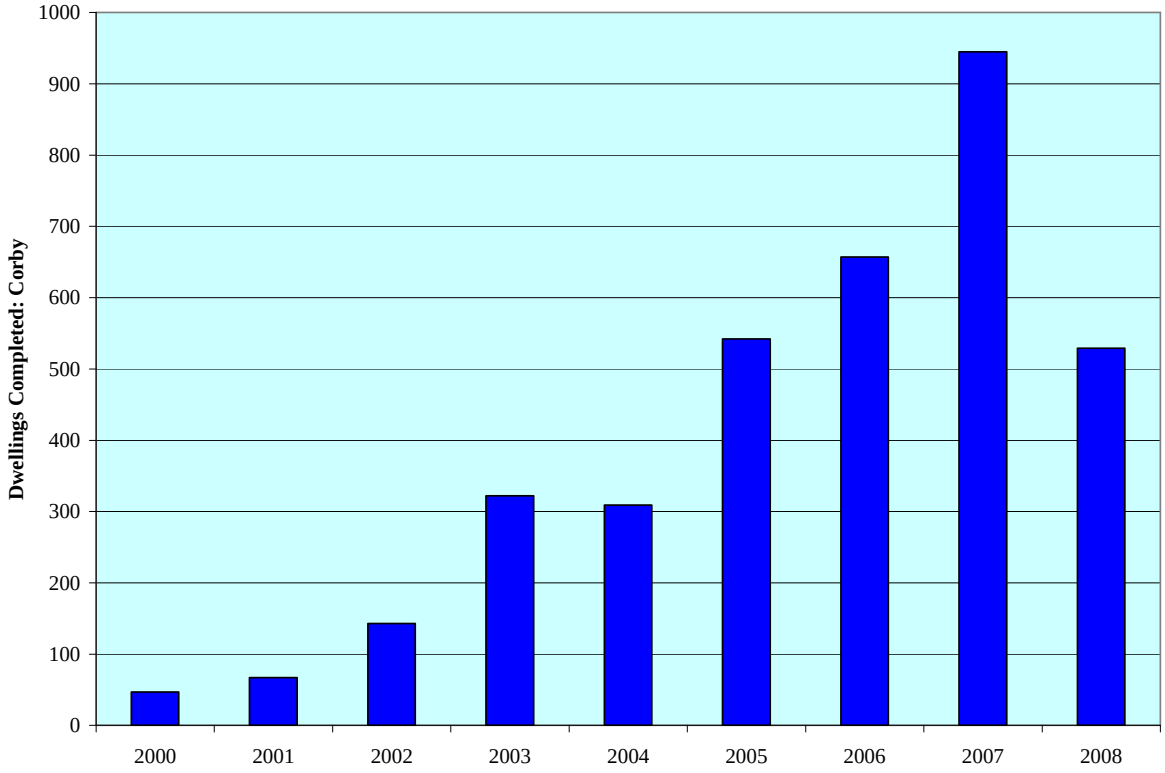

Figure 1: Annual housebuilding rates in Corby 2000-08

According to the North Northants Development Company (the main public sector agency driving forward its transformation), North Northamptonshire's population is due to rise from 285,000 in 2001

[1] The various graphs in this section are derived from Department for Communities and Local Government statistics on housebuilding completions by local authority district up to the end of 2008 and from the Land Use Change Statistics (2007) which give detailed information for each local authority area on the proportion of dwellings built on brownfield (previously developed) land and the density of new residential development. We do not include housing conversions in our brownfield analysis, since no such estimates are provided in LUCS at a regional or local authority level. As a result, there may be some divergence between the brownfield/greenfield split we report below for each local authority area and those reported in the authority's own publications which may allow for conversions.

[2] The other three local authority districts in the 'North Northamptonshire growth area are Kettering, Wellingborough and East Northamptonshire.

to 370,000 in 2021. Corby will take the lion's share of this growth, with its population expected to grow from 53,400 in 2001 to 86,400 in 2021 and thence on to almost 98,000 in 2026. As Figure 1 shows, housebuilding in Corby has already begun to increase significantly.

Such rapid expansion places heavy reliance on greenfield land, with major urban expansions already underway. Others are now planned to the north east (5,100 new homes between 2006 and 2021) and west (4,000 new homes between 2011 and 2021) of Corby's existing area.

Alongside residential development, it is intended to revitalise the town centre, significantly increase employment, provide a range of new leisure facilities and improve local transport. In the latter context, a new railway station with direct connections to central London was opened early in 2009, reinforcing the belief that much of Corby's expansion will serve the Greater London employment market. Indeed, Corby's attraction to London commuters was conveyed in a recent marketing campaign on the London Underground by the less than subtle slogan 'More for your money: Homes in Corby, the next property hotspot, cost 154% less than London'.

What is perhaps most surprising about the North Northamptonshire growth area is that its core strategy has set a brownfield target of 30%, when recent performance, at least in Corby, has been far below this. For as Figure 2 shows, Corby's current housing growth has been driven very largely by greenfield development, with an only marginal increase in density and the balance between greenfield and brownfield development hardly changing between 2000-2003 and 2004-2007.

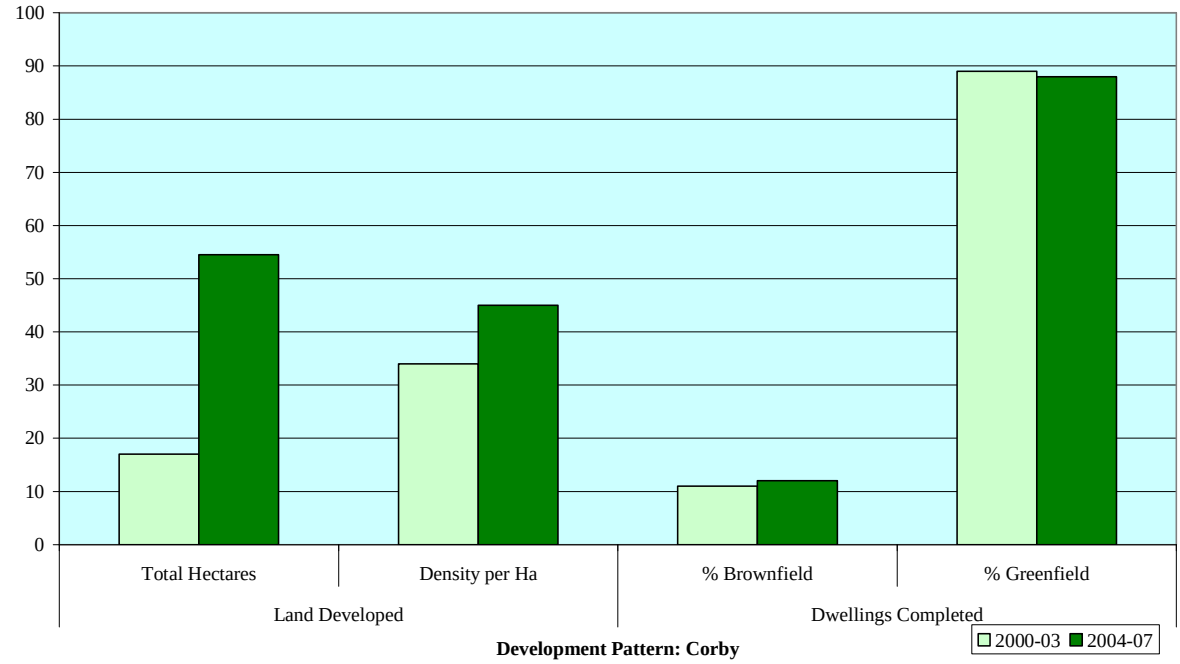

Figure 2: Characteristics of recent residential development in Corby

According to an urban housing capacity study, undertaken in 2004 for Corby Borough Council (2005), brownfield sites had the potential to yield some 2,138 new homes over the 2001 to 2021 period or roughly 13% of the 16,800 dwellings that were expected to be built over that time. From a research perspective, Corby then presents an interesting example of dominant greenfield expansion, which allows the likely impact on the development prospects of the much smaller brownfield supply to be explored.

Eastleigh

Eastleigh is a former railway town in South Hampshire lying between Southampton and Winchester and the main centre of a district that has seen significant recent housing growth, especially at locations such as Hedge End, West End and Fair Oak. Both the M3 and M27 traverse the district, which also contains Southampton International Airport.

By 2007, Eastleigh's population was estimated to have reached about 120,000 accommodated in a dwelling stock of just over 51,500. A further 7,000 dwellings are planned to be built in Eastleigh over the 2006-2026 period on top of the 6,000 to be constructed at the strategic development area of Hedge End, which straddles the district boundary. The borough's population is thus expected to reach almost 135,000 by 2026.

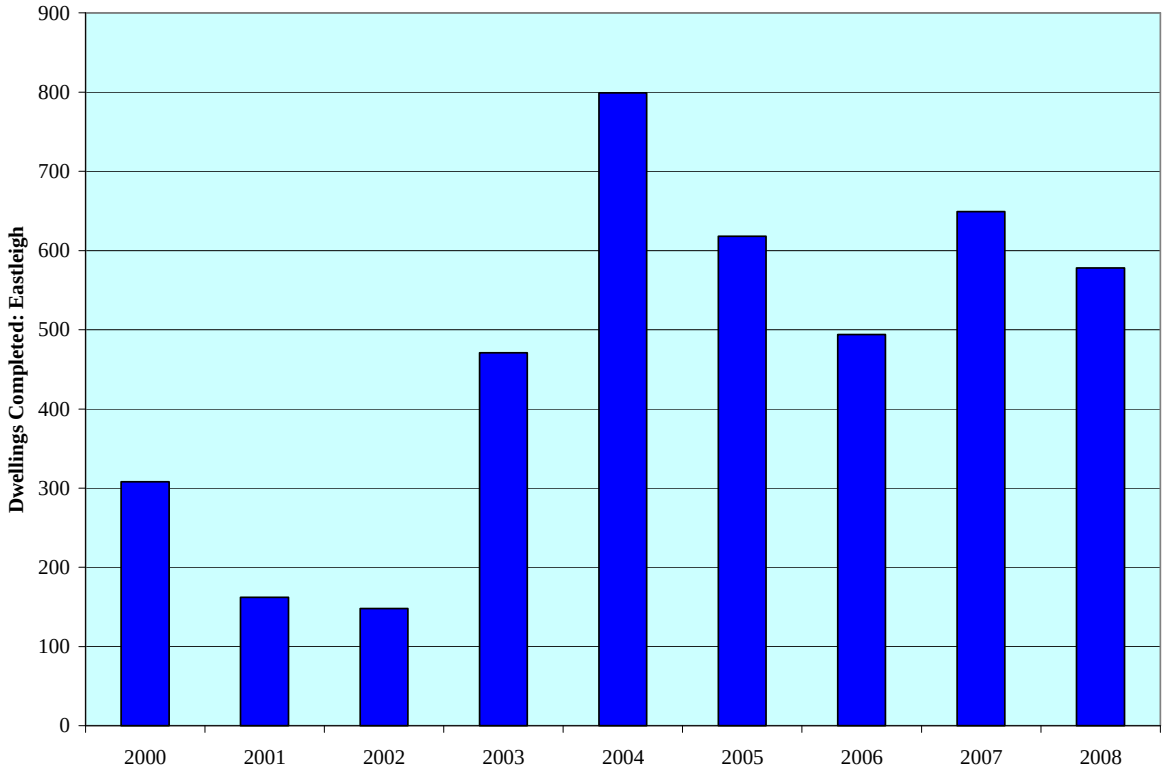

Figure 3: Annual housebuilding rates in Eastleigh 2000-2008

As Figure 3 shows, housebuilding rates in Eastleigh increased significantly in the second half of the decade, with a peak of 800 dwellings completed in 2004. Although subsequent years have not matched this achievement, completion rates at the end of the period still remained three or four times higher than those achieved in 2001 and 2002.

The Eastleigh experience demonstrates convincingly that it is possible to significantly increase residential development while maintaining and even improving on a high brownfield ratio. Redevelopment of former industrial land, such as the transformation by Barratt Homes of the large redundant Pirelli factory into a new residential community known as Park 21, ensured a rising supply of brownfield land in the district.

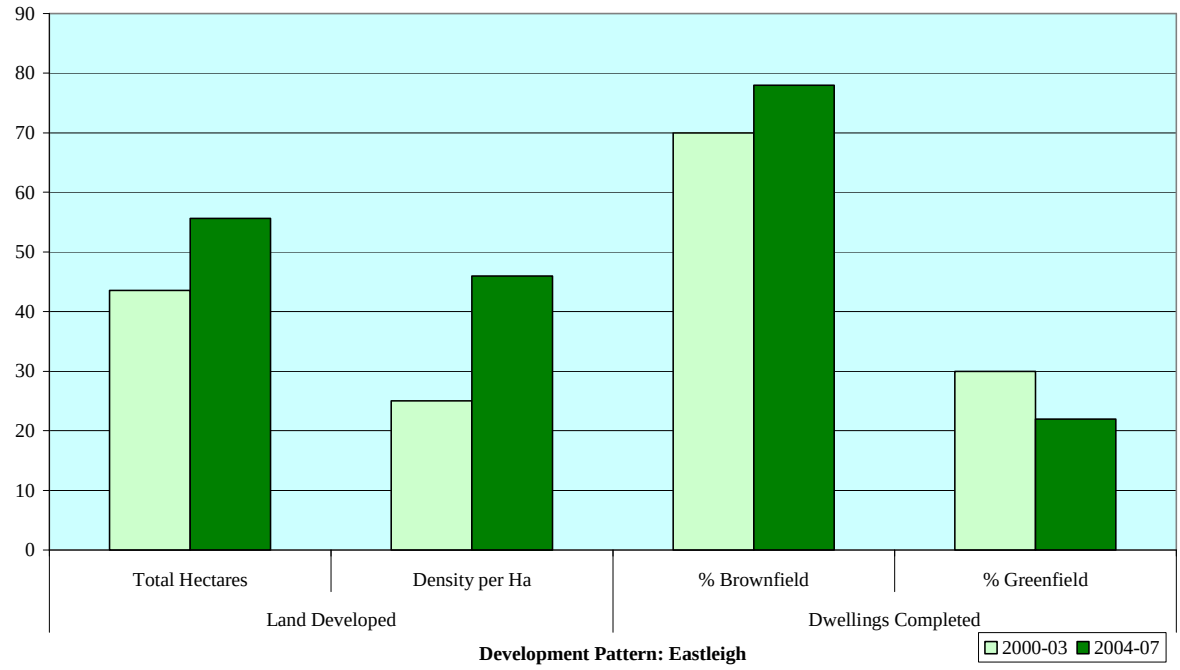

Figure 4: Characteristics of recent residential development in Eastleigh

Yet, as Figure 4 reveals, the key to Eastleigh's success was an almost doubling in the density of new dwellings per hectare, which meant that only limited additional land was necessary as a whole to produce the substantial rise in completion rates in the latter part of the decade. However, greater reliance on planned greenfield releases in later years, for example at South Street, Eastleigh and Dowd's Farm, Hedge End, is expected to tilt the balance away from brownfield reuse in future years.

Leeds

Leeds is one of the UK's main regional centres, with a population of 715,000. Over recent decades, its economy has been transformed from its previous reliance on manufacturing (which accounted for about 75% of the Leeds workforce in the 1950s compared to less than 10% today) by rapid service sector growth especially in retailing and financial services. Its administrative boundary extends well beyond the main urban area of Leeds itself to cover a broader rural hinterland containing outlying towns along with numerous small villages.

The city sits at the centre of the Leeds City Region – a partnership forged with ten neighbouring local authorities with the intention (*City Region Development Programme*, Leeds City Council, 2006: 2) to 'develop an internationally recognised city region; to raise our economic performance; to spread prosperity across the whole of our city region, and to promote a better quality of life for all of those who live and work here.'

The Leeds Unitary Development Plan, which was finally adopted in 2001 after a 12-year period of preparation, made provision for 28,500 new dwellings between 1991 and 2006, equivalent to a net increase of about 1,900 each year. The subsequent 2006 review of the plan, reflecting the slightly higher requirements of regional planning guidance raised this figure to 1,930 dwellings per annum during the 1998-2016 period. The review sought to concentrate new development on brownfield sites in the urban core of Leeds, including the nearby towns of Morley, Rothwell, Pudsey, Horsforth and Aireborough or in the outlying towns of Otley and Wetherby.

Three strategic brownfield developments were planned at Holbeck Village, Hunslet Riverside and Allerton Bywater, along with a fourth greenfield location at Sharp Lane, Middleton in the south of the city and a fifth scheme known as the East Leeds Extension, which was seen as a major potential greenfield development in later years.

More recent planning strategies envisage a significant upward step in housing delivery. The Regional Spatial Strategy for Yorkshire and The Humber, for example, published in 2008, sets an annual net target of 2,260 units between 2004 and 2008 and 4,300 units between 2008 and 2026, which translate into gross requirements of 2,700 and 4,300 units per annum respectively. These targets have been taken forward in current planning of the Local Development Framework for Leeds.

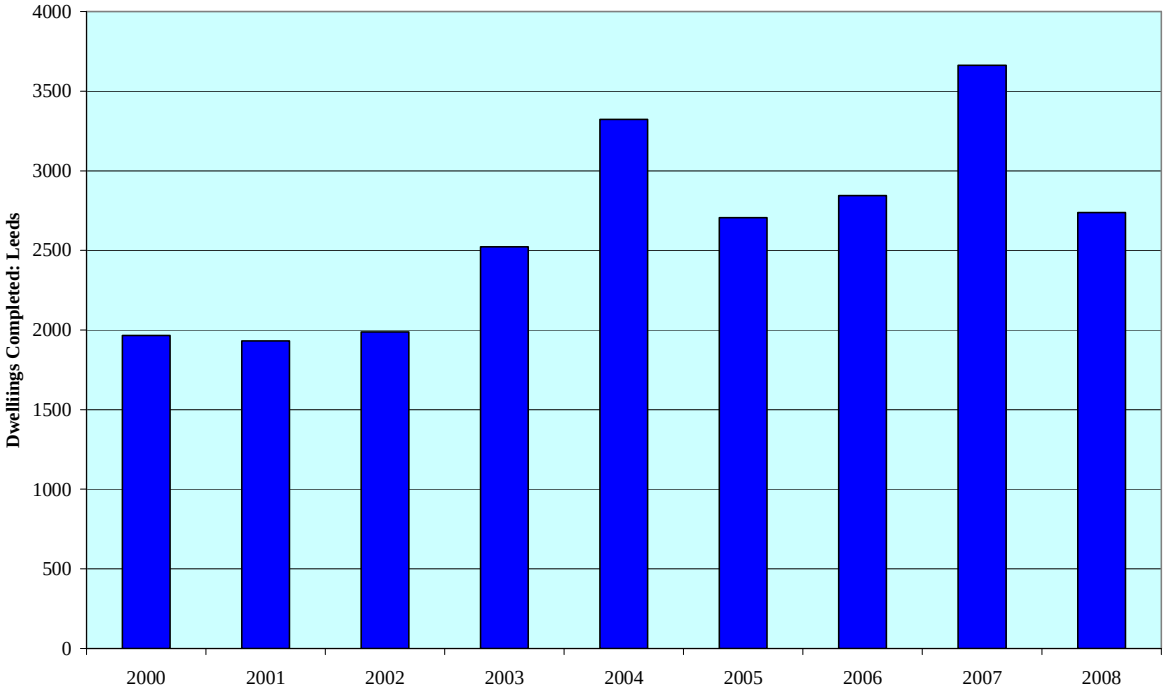

Figure 5: Annual housebuilding rates in Leeds 2000-2008

Annual completions data show that the Leeds housing market has been highly buoyant in recent times. Early in this decade, Leeds produced a consistent output of almost 2,000 new dwellings per annum, but as Figure 5 shows, this increased significantly in later years to a maximum figure of over 3,600 completions in 2007 at the height of the housing boom.

Despite much higher rates of housebuilding in Leeds towards the end of the decade, land-take actually fell, primarily as a result of an increase in the density of new dwellings from 35 per hectare in the 2000-2003 period to 61 per hectare in the 2004-2007 period. This is shown in Figure 6.

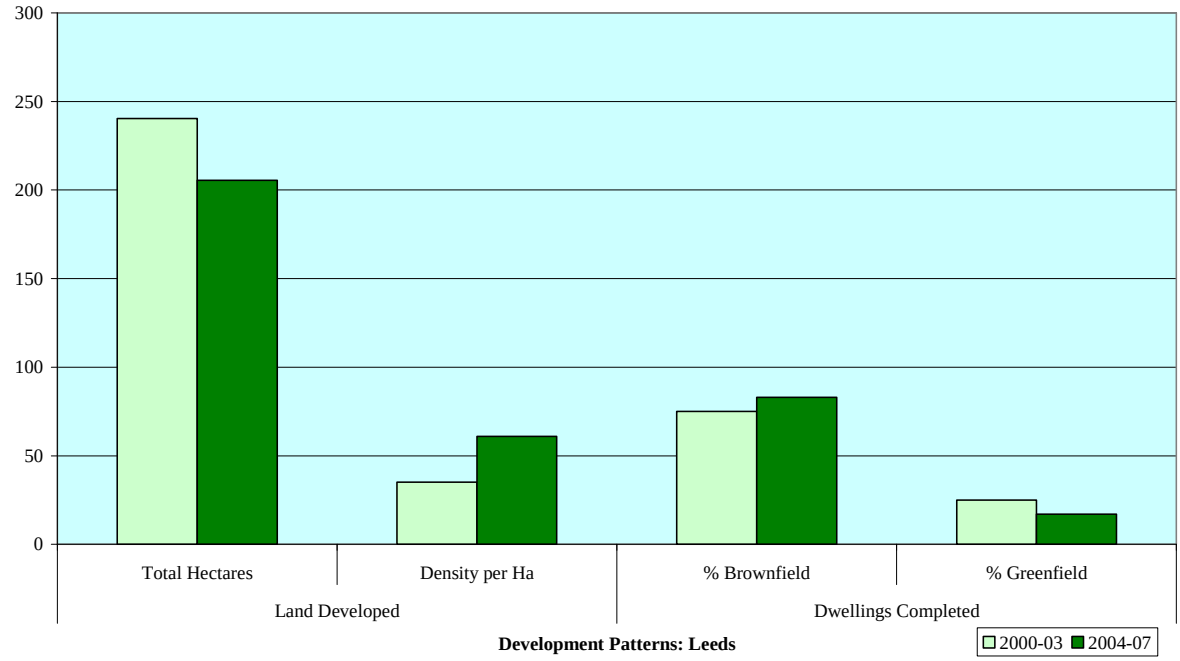

Figure 6: Characteristics of recent residential development in Leeds

Leeds has been at the forefront of the recent boom in high density city centre apartments, with over 5,700 completed in the 2003-2007 period and a further 3,800 under construction at the end of that period (Unsworth, *Town Planning Review*, 2007). However, as Figure 6 shows, while brownfield development became thus even more dominant later in the decade, the sheer scale of new homes built each year in Leeds meant that greenfield development remained important in absolute terms, even though it further diminished in relative terms.

Leicester

Leicester is the largest city in the East Midlands, with a population of 285,000. Although an important regional service centre, its manufacturing base remains significant at approximately 24% of the workforce. The city boundaries are tightly drawn, with some important outer suburbs located in the adjoining districts of Blaby, Charnwood and Oadby and Wigston, which puts the overall population of the wider Leicester urban area at around 440,000.

Some 19,000 new dwellings were planned to be built in Leicester itself over the 1996 to 2016 period, according to the Leicestershire, Leicester and Rutland Structure Plan (2005). Drawing on the findings of an urban capacity study, the subsequent City of Leicester Local Plan (2006) suggested that 69% of the new housing requirement could be built on brownfield sites. However, it also noted that this target might be difficult to maintain in the later stages of the plan, if increased greenfield development were to take place at the major peripheral locations of Hamilton and Beaumont Leys. Indeed, the plan allocated new land for 2,830 new dwellings on major greenfield extensions at Ashton Green and Hamilton, which the local authority considered essential to meet structure plan requirements, despite the overall priority accorded to brownfield development.

The draft Regional Spatial Strategy for the East Midlands, published in 2006, suggested an increased annual housebuilding rate of 1,180 in Leicester over the 2001 to 2026 period, within the context of a 60% brownfield target for the region as a whole. In September 2006, however, Leicester was included in the 'three cities and three counties' growth point of Derby, Leicester and Nottingham, with the shared commitment to provide an additional 81,500 homes across the growth point as a whole by

2016. Nevertheless, the final Regional Spatial Strategy for the East Midlands, published in 2009, raised the annual housebuilding target Leicester over the 2001 to 2026 period by only 100 to 1,280. According to a housing land availability assessment carried out by Roger Tym and Partners (2007, Executive Summary, paragraph 5) for the respective local authorities, in the Leicester urban area as a whole 'The total level of average output will have to double what has been achieved over the last five years.' Moreover, it suggested that across the urban area as a whole, brownfield development would be unlikely to exceed 55% of the total.

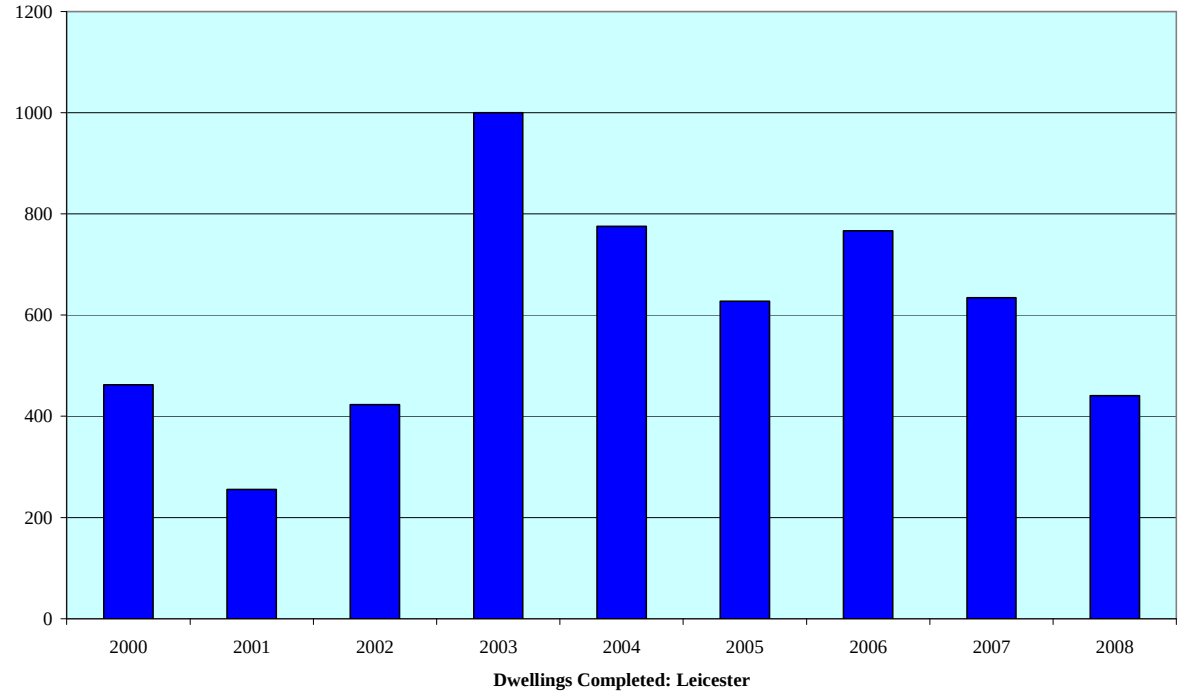

Figure 7: Annual housebuilding rates in Leicester 2000-2008

Recent annual completions data for Leicester itself shows that the production of new homes peaked much earlier than in other case study locations, with output reaching a maximum of 1,000 in 2004. As Figure 7 indicates, the subsequent downward trend in output meant that production by 2008 had returned to the much lower figures recorded for 2001 and 2003. Against recent achievements, even the draft Regional Spatial Strategy proposal of 1,180 new homes to be built annually seems highly ambitious.

Looking in more detail at the development pattern in Leicester (see Figure 8) reveals a greater reliance on greenfield development in the later part of the decade, with only a limited increase evident in the density of new dwellings per hectare. Leicester found it difficult to reconcile much higher levels of output with maintaining its earlier emphasis on brownfield development and thus presents almost the opposite picture to that encountered in Eastleigh. As intimated in the various planning documents, it is possible that greenfield sites will need to make a stronger contribution to housing production in the years ahead, if the city's status as a growth point is indeed to be evident in some of the target figures that have been suggested.

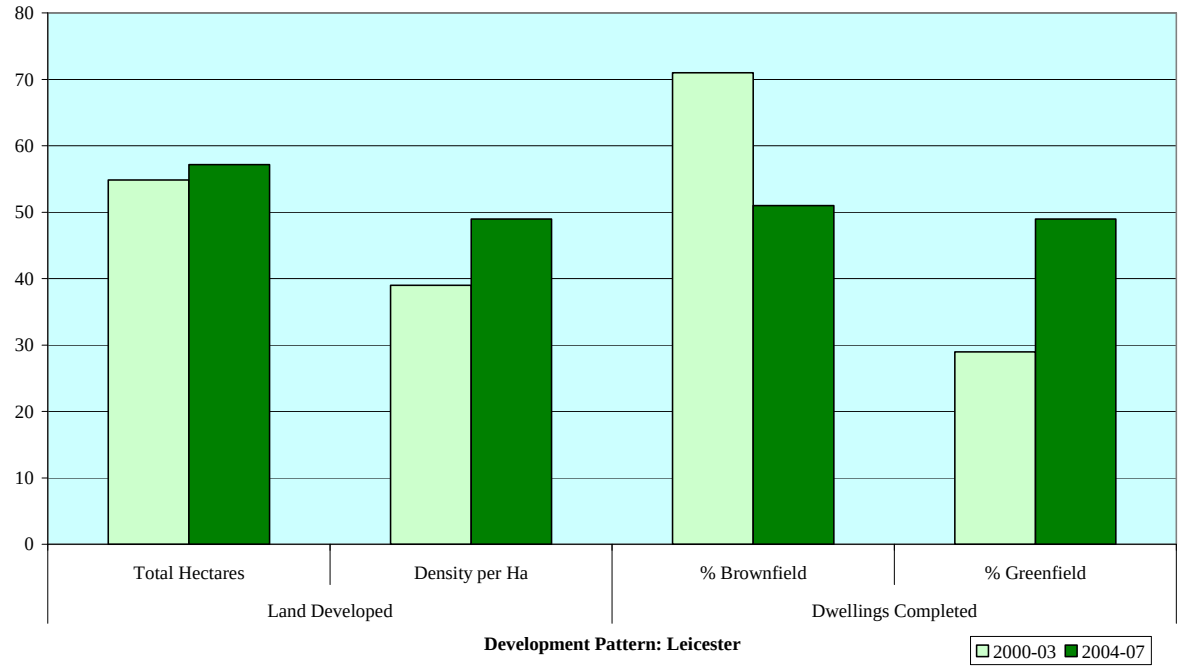

Figure 8: Characteristics of recent residential development in Leicester

North Tyneside

North Tyneside lies immediately to the east of Newcastle and its main towns of North Shields, Wallsend and Whitley Bay form part of a continuous built-up area. Its 2001 population stood at 192,000, which represented a decline of 1.8% over the previous decade, much lower than had been experienced in the 1980s and 1970s. The Unitary Development Plan of 2002 envisaged future population growth and included proposals for major greenfield development at Backworth, Shiremoor and West Allotment in the A19 growth corridor northwards to Northumberland, to be served by a new district centre and a new station on the Metro line

The Regional Spatial Strategy for the North East of England, approved in 2008, envisaged the development of some 7,800 new homes in North Tyneside between 2004-2005 and 2020-2021, equivalent to an annual figure of about 460. Almost immediately, however, North Tyneside's designation as a growth point later in 2008 added over 1,000 dwellings to the Regional Spatial Strategy and lifted the annual requirement to 586. In the current recession, there must some doubt about the delivery of such ambitious plans in what is not the strongest housing market studied in the research.

Looking at recent housing production in North Tyneside, it is difficult to see any consistent trend although as Figure 9 suggests, the district seems to have experienced a much sharper decline in housebuilding in 2008 than any of the other case study locations, again questioning the adopted growth strategy.

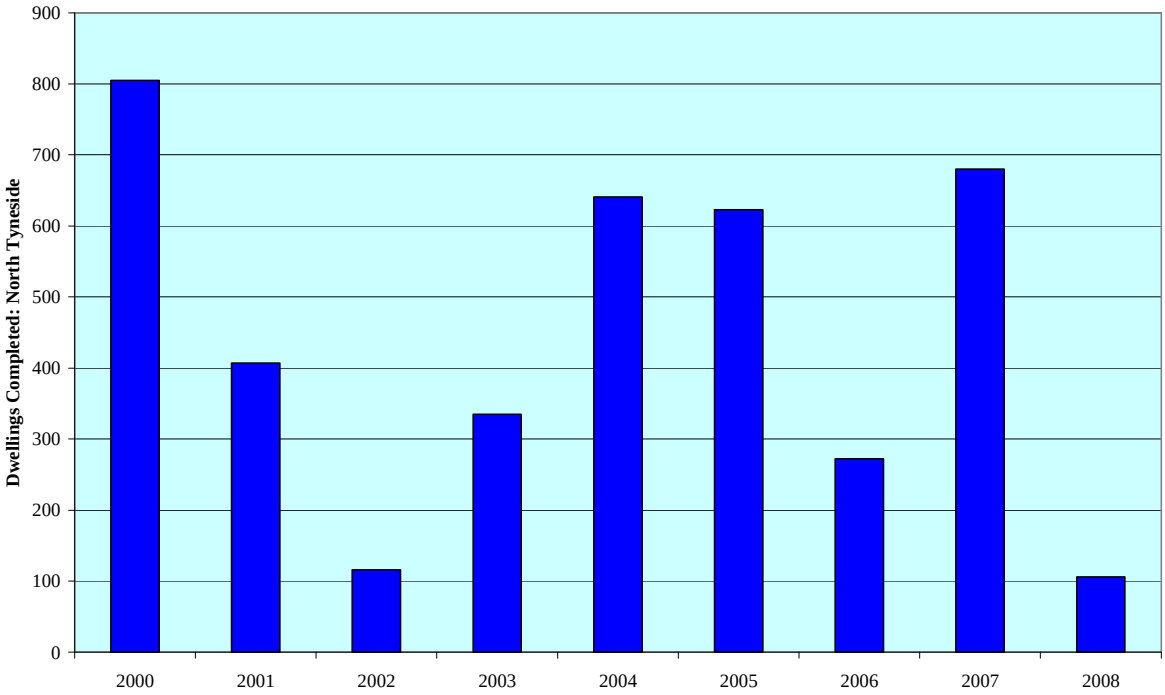

Figure 9: Annual housebuilding rates in North Tyneside 2000-2008

Despite highly variable rates of new housebuilding, overall land-take in North Tyneside remained remarkably consistent between the earlier and later periods shown in Figure 10. This was because the impact of a relative switch in favour of greenfield development seems to have been cancelled out by a rise in the density of new dwellings from 37 to 49 per hectare.

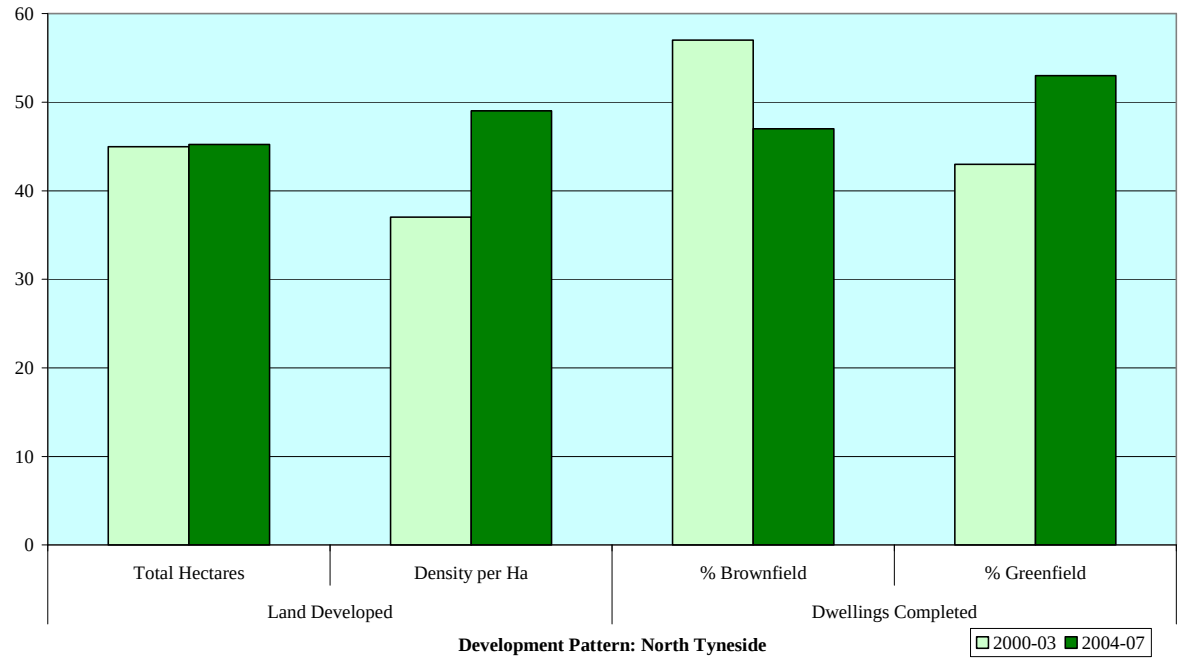

Figure 10: Characteristics of recent residential development in North Tyneside

Southampton

Southampton is a major freestanding city of 231,000 people on the south coast and a longstanding maritime and service centre. It has a substantial legacy of brownfield land as a result of the decline in shipbuilding and ship repair and in traditional industry such as the manufacture of sub-sea cables. The city is already largely built up and has little room for peripheral expansion within its tight administrative boundary, indeed, parts of the neighbouring districts of Eastleigh and Test Valley serve as important suburban areas for Southampton

The Hampshire Structure Plan 1996 envisaged an annual housebuilding rate of 500 new homes within in the city or 7,330 in total up to 2011. However, the buoyant economy and the unexpected availability of large brownfield sites have caused this rate of building to be exceeded in recent years and later policy documents thus propose a higher rate of development in future. As a result, according to the draft South East Plan for South Hampshire 2008, some 16,300 new homes are expected to be built in Southampton between 2006 and 2026, which is equivalent to 815 per annum.

Southampton's Local Development Framework Core Strategy, also published in 2008, places continued importance on major residential development in the city centre, with about 5,400 new homes to be built there over the plan period and a further 6.400 to be dispersed on smaller sites within residential neighbourhoods. Crucially, in view of Southampton's tight urban boundary, there are no proposals for major greenfield release and a 95% brownfield target is set.

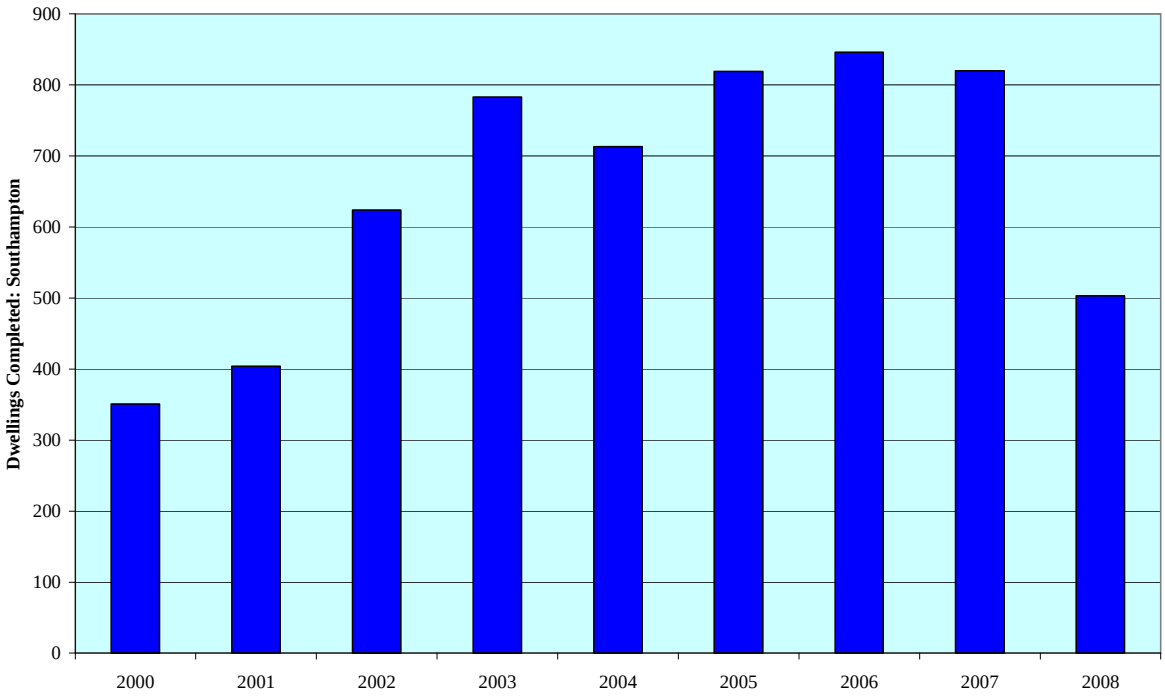

Figure 11: Annual housebuilding rates in Southampton 2000-2008

As Figure 11 shows, Southampton saw an upward trend in completion rates in the middle part of the period, which remained high until the recession began to have a serious impact in 2008. City centre apartment building was particularly important in the middle part of the decade and that market may well be disproportionately affected by the recession.

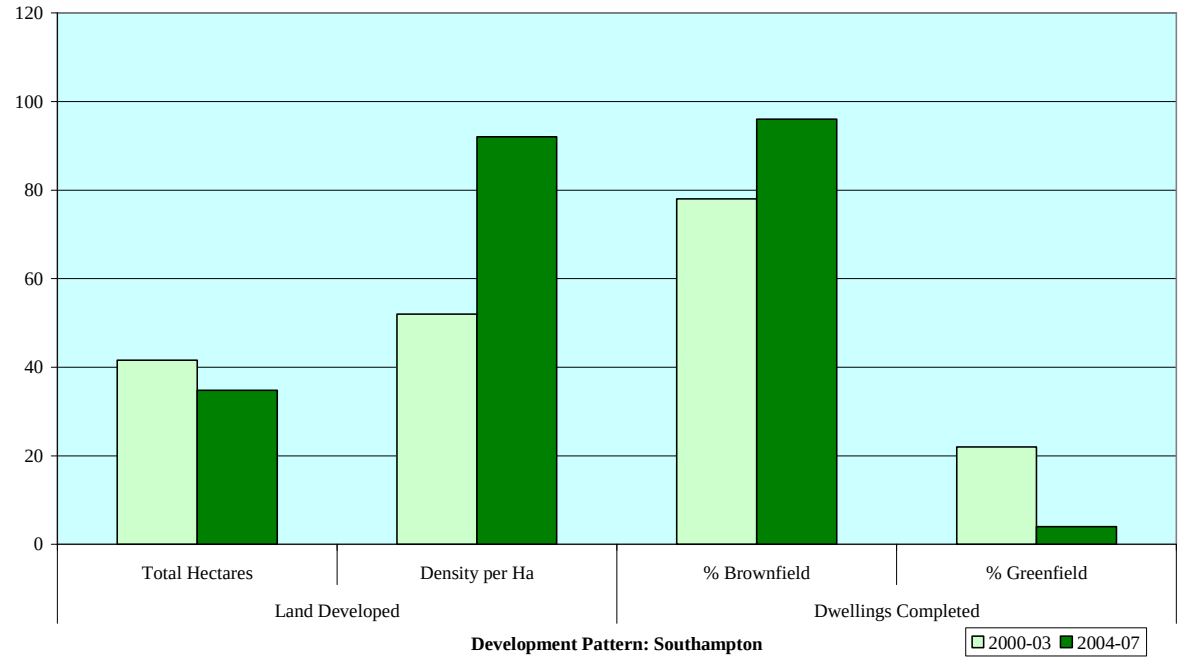

Figure 12: Characteristics of recent residential development in Southampton

Looking in more detail at the development pattern in Southampton (see Figure 12) demonstrates the crucial importance of the rise in the density of new dwellings from 52 per hectare in 2000-2003 to 92 per hectare in 2004-2007. This helped reconcile increased housing production with the further fall in the importance of greenfield compared to brownfield development and meant that overall land-take was actually lower in the later part of the study period. The city's legacy of brownfield land is expected to continue to provide a steady stream of development sites, such as the former Vosper Thornycroft industrial complex (now remained Woolston – Centenary Quay) which is expected to yield 1,600 new homes and Royal Pier – Mayflower Park, where around another thousand dwellings are likely to be built.

Suffolk Coastal

Suffolk Coastal is a predominantly rural authority, immediately to the north east of Ipswich in East Anglia, although some of the outer suburbs of Ipswich actually fall within its boundary. In settlement terms, however, the district is dominated by the port of Felixstowe on its south eastern area, which contains just under a quarter of the district's population of 122,000 in 2006. Like many similar areas, Suffolk Coastal has seen significant population growth in recent decades, with an increase of just under 30% in the last 30 years. The southern part of Suffolk Coastal is now part of the Haven Gateway Partnership, a designated growth point covering the ports of Felixstowe, Harwich, Ipswich, Mistley and their surrounding areas.

Housing growth is likely to continue in Suffolk Coastal for the foreseeable future, with the East of England Regional Spatial Strategy, approved in 2008, expecting to see provision of an additional 10,200 dwellings in the district over the period 2001-2021. Of these, 3,000 will be concentrated on the edge of Ipswich, mainly on major greenfield allocations. The other main area of search will be around Felixstowe, again involving substantial greenfield development.

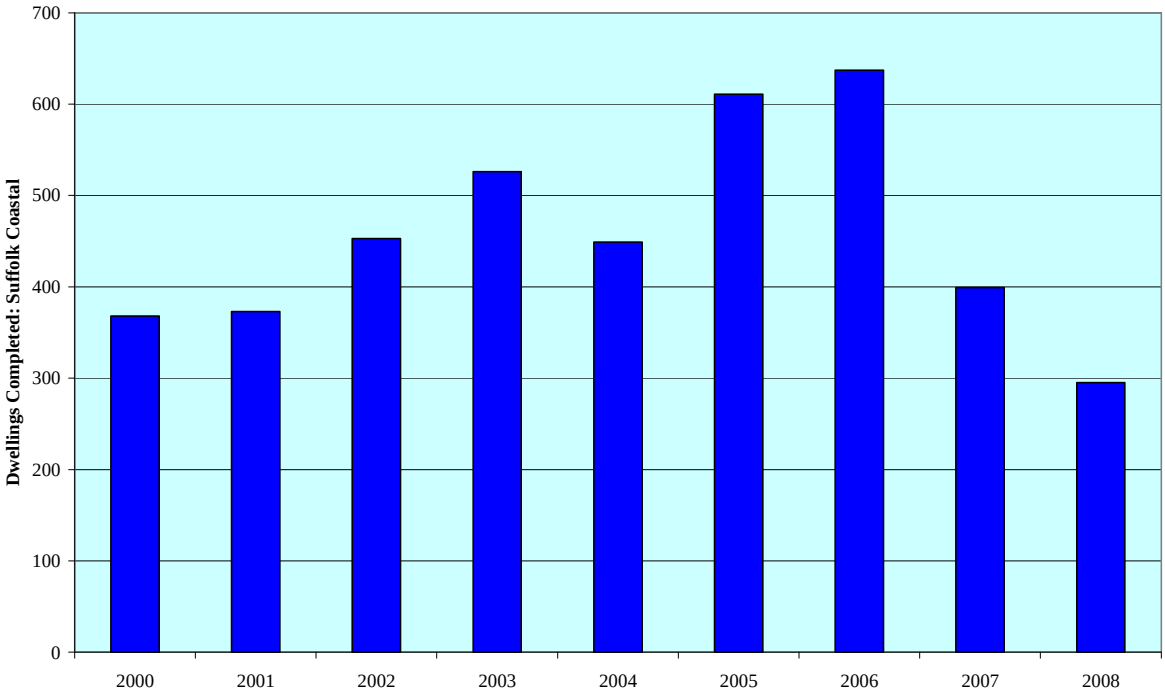

Figure 13: Annual housebuilding rates in Suffolk Coastal 2000-2008

Unusually, Suffolk Coastal presents almost a bell curve distribution in recent housing production with a steady increase in output (apart from 2004), reaching a peak of over 600 new homes built in 2006 and then rapidly falling away as the recession began to bite. The Regional Spatial Strategy target means that production will need to settle at the higher levels of the bell curve in order to deliver the target of just over 500 dwellings annually during the plan period.

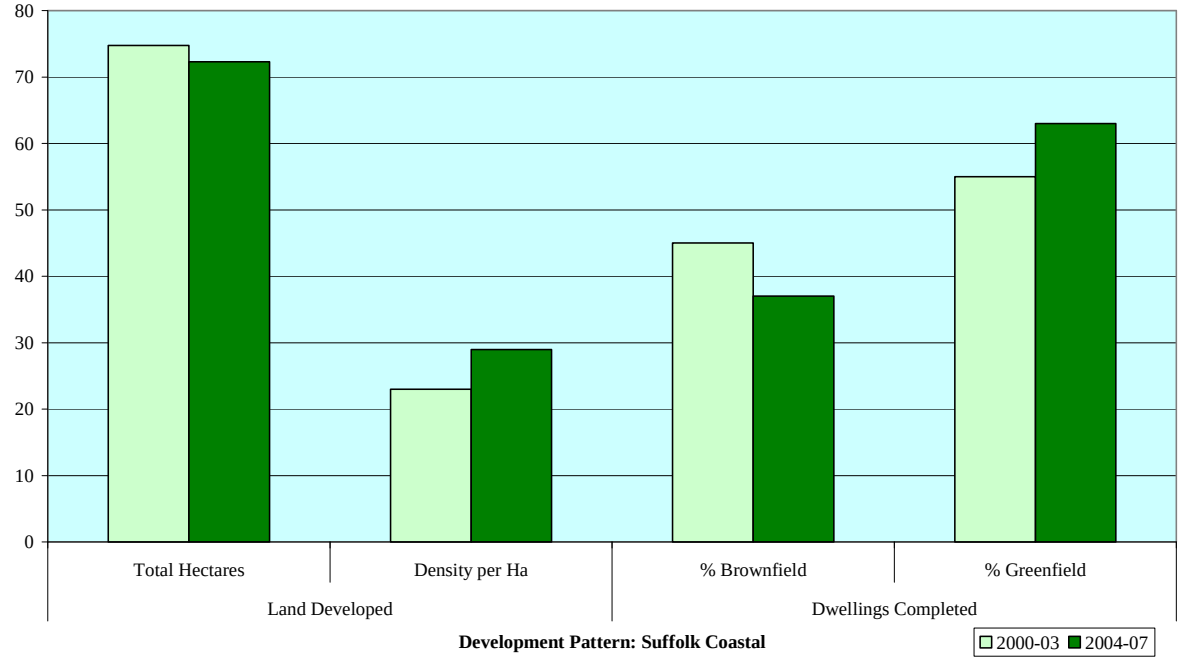

Figure 14: Characteristics of recent residential development in Suffolk Coastal

A closer inspection of recent development patterns in Suffolk Coastal reveals a marginal increase in the relative importance of greenfield development in the later period of the survey, possibly associated with the peak completions years of 2005 and 2006. However, as Table 14 demonstrates, a small rise in the density of new dwellings per hectare seems to have acted as a counterweight and ensured that overall land-take fell slightly in the later period.

While the Local Development Framework Core Strategy identifies some minor opportunities for brownfield development within existing towns and villages, it comments that potential in the main urban area of Felixstowe is limited, primarily because of the shortage of redundant sites in an expanding port and the constraints imposed by flood risk in the context of climate change. It is therefore likely that Suffolk Coastal will become increasingly dependent on greenfield development to achieve the housing target set in the Regional Spatial Strategy.

Swindon

Swindon has been the most significant growth location in Wiltshire for some decades. Strategically located alongside the M4 and on the mainline train route between London and Bristol, its expansion can be traced back to designation under the Town Development Act 1952. Under more locally-based policies, the town's population has grown from 129,000 to 160,000 over the past 25 years within a total for the borough as a whole of 189,500. In recent years, the focus of peripheral expansion has been on the Northern Development Area, which saw almost 5,500 houses completed between 2001 and 2008. Apart from Corby, Swindon registered the most noticeable increase in housebuilding of any case study location in the first decade of this century, with over 2000 completions recorded in 2007, a figure over five times that of 2001. This is shown in Figure 15.

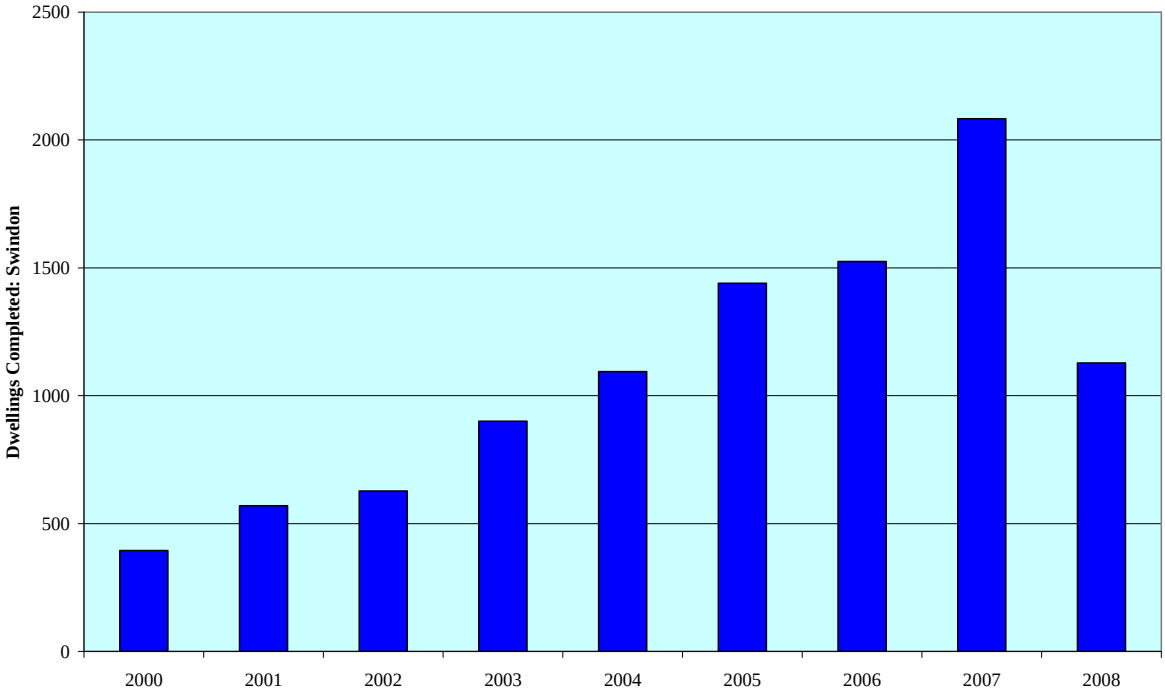

Figure 15: Annual housebuilding rates in Swindon 2000-2008

In 2007, Swindon was designated as one of the Government's first round of growth points. This brought in additional investment of over £3 million in the first year. Priorities include town centre regeneration, which will provide around 3.000 additional homes, the major new development of Wichelstowe to the south of Swindon bringing a further 4,500 dwellings, the Commonhead development including 1,800 dwellings around a new university campus, completion of the Northern Development Area by 2011 and ultimately a strategic urban extension to the east capable of accommodating up to 12,000 dwellings. It is therefore no surprise that the Draft Regional Spatial Strategy envisages the development of 35,000 new dwellings in the Swindon area between 2006 and 2026, of which 17,700 will be built by 2016.

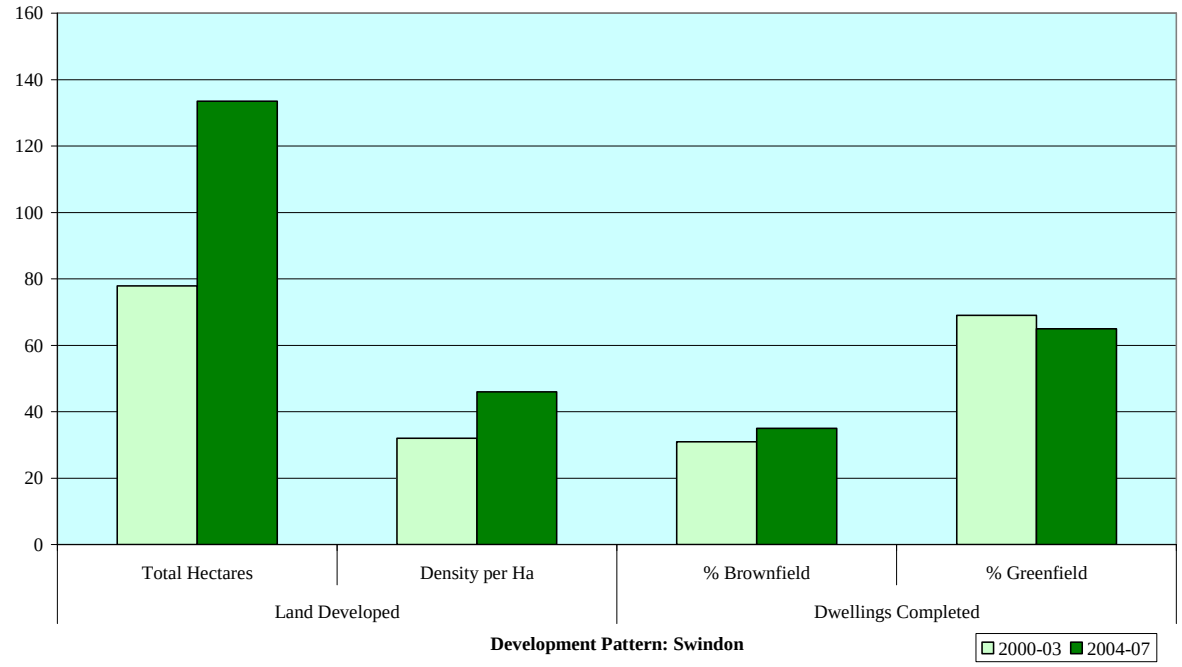

Figure 16: Characteristics of recent residential development in Swindon

Interestingly, as Figure 16 shows, the recent rapid rise in Swindon's housing output was achieved alongside a marginal increase in the relative importance of brownfield development, although no significant increase was recorded in density. A constant flow of relatively small brownfield sites appears to have accounted for this recent increase since the small geographical area occupied by Swindon prior to major postwar expansion did not contain large areas of industrial employment, apart of course from the railway lands.

Wigan

Wigan is at the north-western corner of the Greater Manchester conurbation and has a population of just over 300,000. It is an extensive borough in land terms, comprising the town itself and several adjoining settlements, most notably the towns of Ashton-in-Makerfield, Hindley, Ince-in-Makerfield and Leigh. The district is well connected, being on the M6 and the west coast main train line and has been a popular development location in recent years. Like many similar areas, Wigan has suffered significant deindustrialisation in recent decades, creating a ready supply of brownfield land for redevelopment.

Regional Planning Guidance for the North West, published in 2003, set Wigan a housebuilding target of 510 new dwellings a year, which allowing for demolitions of around 100 annually, translated into a net addition of 410. This level was incorporated within the Unitary Development Plan for Wigan, last revised in 2006. However, as Figure 17 shows, residential completions in Wigan saw an upward trajectory from 2002, reaching a peak of over 1,600 new homes built in 2007. The revised Regional Spatial Strategy, approved in 2008, took advantage of the higher level of housebuilding and set a new net target of 978 completions per annum. However, this may not be achievable in the immediate future as the impact of the recession on housebuilding in 2008 seems to have been felt much harder in Wigan than in other case study locations.

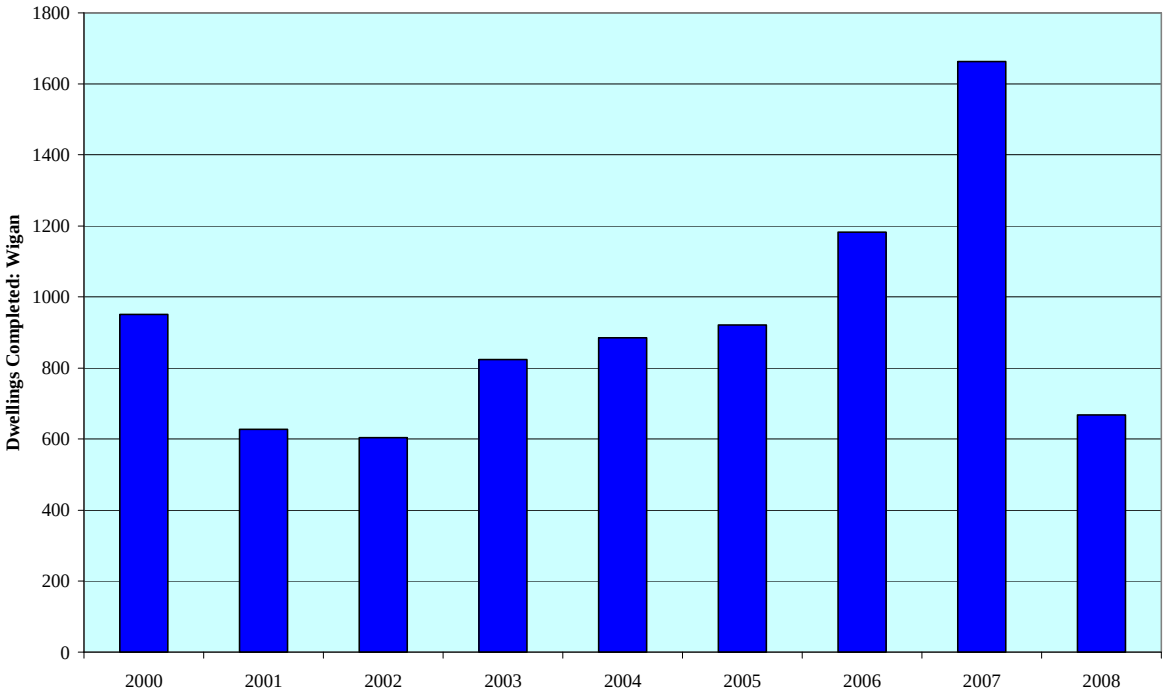

Figure 17: Annual housebuilding rates in Wigan 2000-2008

Against a Regional Spatial Strategy brownfield target of 80% for Greater Manchester, Wigan saw a minor shift in favour of greenfield development in the later period, although brownfield development remained dominant. Nevertheless, as Figure 18 also reveals, a significant rise in the density of new dwellings from 27 per hectare in 2000-2003 to 43 per hectare in 2004-2007 meant that this relative switch towards greenfield development was achieved alongside a slight reduction in overall land-take. However, in the Local Development Framework Core Strategy Issues and Options Report, published in 2008, the local authority expressed concern at the extensive recent development of apartments in the borough, which were considered not to be particularly sensitive to their context or indeed locally distinctive.

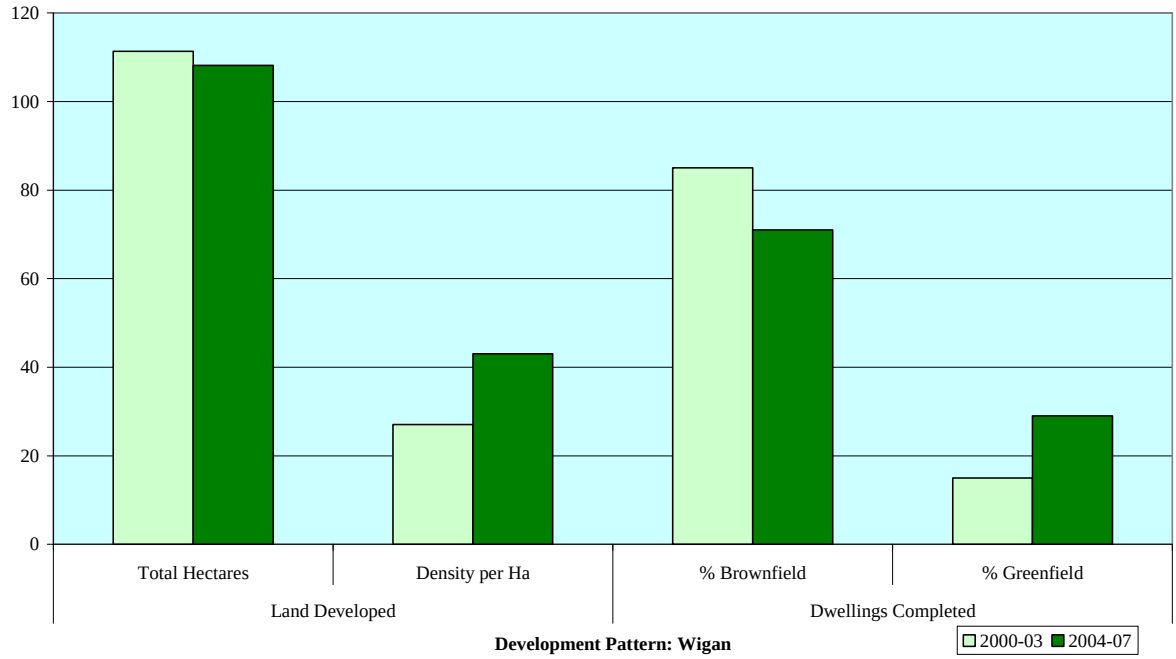

Figure 18: Characteristics of recent residential development in Wigan

Conclusions

Greenfield development was dominant in only three of the nine case study locations - Corby, Suffolk Coastal and Swindon and in the last two of these, brownfield development was still significant in absolute terms. Corby was thus unusual because its growth area status was combined with a very limited brownfield output. In contrast, Eastleigh, Leeds, Southampton and Wigan were heavily reliant on brownfield development, especially in the later part of the study period, although in the case of Leeds, in particular, the sheer amount of new housing built meant that greenfield land was still significant in absolute terms. Both Leicester and North Tyneside present more mixed pictures, with a more even balance between greenfield and brownfield residential development, especially in the later period. As a whole, then, the case studies provide a useful variation in circumstances to allow the potential link between greenfield development and brownfield viability to be explored in detail.

Appendix 2: The Development Site Build Rate Model

The build rate model is very simple in construction. It is estimated using Emap-Glenigan data for the period 2002-2008 and draws on information on projected development periods available in these digitised planning records. The model is driven largely by the number of units in a development, together with the split between the number of housing units and flatted units proposed on site. A quadratic term (squared units) allows for the concept of economics/diseconomies of scale. The detailed results are shown below.

Variable	Coefficient	t statistic	
Constant	9.141	219.65	***
Squared number of units	-3.2E-05	-12.32	***
Number of flats to be constructed on site	0.059	58.25	***
Number of houses to be constructed on site	0.061	68.09	***
Development comprises only flats	-1.013	-18.84	***

Note: *** denotes significant at the 1% level

Adjusted R square:	0.763
F statistic:	3599.431
Number of observations:	4480

The results indicate a robust model, with an adjusted R square of 0.763. The number of both flats and houses proposed in a particular development increases the expected development period at different rates. Meanwhile, the quadratic term is both statistically significant and negatively signed. This suggests that larger developments have slightly shorter development periods per unit proposed than smaller developments.

Appendix 3: The Construction Cost Model

The construction cost model is also very simple in construction. Construction cost estimates were available in just under 8,000 relevant (residential development) observations in the dataset. Although extensive experimentation with more complex specifications was carried out, the final model is driven by a limited set of explanatory variables as shown below.

Variable	Coefficient	t statistic	
Constant	335,676	26.05	***
Number of flats	29,465	127.20	***
Number of houses	40,154	201.65	***
Number of luxury houses	40,715	77.68	***
Number of bungalows	25,935	29.52	***
Squared number of units	51.46	141.40	***
Adjustment for 2004	313,841	6.85	***
Adjustment for 2005	543,779	12.50	***
Adjustment for 2006	464,763	10.90	***
Adjustment for 2007	563,641	13.80	***
Adjustment for 2008	488,640	10.65	***
Adjustment for London Government Office region	123,315	3.92	***
Adjustment for North East Government Office region	87,423	2.29	**
Adjustment for North West Government Office region	-49,437	-2.00	**
Adjustment for West Midlands Government Office region	-84,759	-2.52	**
Adjustment for Yorkshire & The Humber Government Office region	-60,238	-2.48	**

Note: *** denotes statistically significant at the 1% level; ** at the 5% level.

Adjusted R square:	0.946
F statistic:	9175.85
Number of observations:	7835

As the results show, residential development construction costs can be explained with regards to the number of flats and houses proposed on site. Bungalows and units described as luxury houses have a slightly different impact on total construction costs than units simply described as houses. A quadratic term (squared number of units) is also statistically significant and this indicates that per unit construction costs rise with development size.

The model is estimated over a number of years (2002-2008). Time dummy variables capture the effects of construction cost inflation. The model initially assumes that all projects take place in 2002. The variable for 2003 was not statistically significant and so it drops out of the model. The coefficients for the 2004-2008 time dummy variables capture the higher construction costs in those years, compared with 2002 and 2003.

A set of regional variables captures differences in construction costs between government office regions. Although most of these are statistically significant, the impact on overall predicted construction costs is relatively small, except in the case of very small sites.

The statistical results allow the prediction of construction costs related to time period, regional location and broad description of development proposal. For example, the following table summarises the prediction of construction costs associated with hypothetical developments of 40 flats, 40 luxury houses and a combination of 20 flats and 20 non luxury houses based on the South East government office region.

Year	Site of 40 flats (construction costs in £s)	Site of 40 luxury houses (construction costs in £s)	Site of 20 flats and 20 houses (construction costs in £s)
2002	1,596,605	2,046,626	1,810,389
2003	1,596,605	2,046,626	1,810,389
2004	1,910,446	2,360,467	2,124,230
2005	2,140,385	2,590,405	2,354,168
2006	2,061,369	2,511,389	2,275,152
2007	2,160,247	2,610,267	2,374,040
2008	2,085,246	2,535,266	2,299,040

If the predictions take in the regional variation in costs revealed by the government office region dummy variables then the following predicted construction costs are obtained for a site comprising 20 flats and 20 non luxury houses for the year 2008:

Government Office region	Site of 20 flats and 20 houses, 2008 (construction costs in £s)
East Midlands	2,299,029
East of England	2,299,029
London	2,422,344
North East	2,386,452
North West	2,249,592
South East	2,299,029
South West	2,299,029
West Midlands	2,214,270
Yorkshire and The Humber	2,238,791

Appendix 4: The New-Build House Price Model

The house price models are estimated separately for each local authority area, and form part of wider results from a different, unfunded research project. Drawing on Nationwide Building Society data, the models are estimated for the 2002-2007 study period (complete data for 2008 was not available at the point of model estimation).

The models follow the standard convention hedonic house price conventions. Time dummy variables capture house price trends over time. A range of variables describes physical housing characteristics including, for example, floor area, number of bedrooms, number of bathrooms and parking arrangements.

The models provide a unique level of additional detail in terms of spatial variation in house prices. This is achieved partly by the separate estimation of models at local authority area level, and partly using a multi-level model design. This multi-level approach allows the estimation of a neighbourhood price premium (at Ward level). This, combined with the new-build premium, permits the model to be used for the purpose of estimating new-build property prices by property type and location with the local authority area. The estimation results are shown below, for reference purposes.

Corby house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.023	0.068	161.11	***
2003 premium	0.225	0.026	8.65	***
2004 premium	0.384	0.028	13.64	***
2005 premium	0.436	0.033	13.15	***
2006 premium	0.551	0.027	20.58	***
2007 premium	0.641	0.027	24.12	***
Square feet	0.0004439	0.0000604	7.35	***
Square feet2	7.85E-08	4.31E-08	1.82	*
Built before 1971	-0.075	0.024	-3.2	***
New-build	0.095	0.05	1.91	*
No central heating	-0.155	0.061	-2.55	**
Single garage	0.094	0.019	4.89	***
Double garage	0.229	0.043	5.39	***
Detached	0.102	0.027	3.74	***
Terraced	-0.135	0.022	-6.26	***
Detached bungalow	0.282	0.054	5.21	***
Flat	-0.285	0.061	-4.63	***
Converted flat	-0.277	0.106	-2.61	***
Leasehold	-0.288	0.129	-2.24	**
Second bedroom	0.104	0.052	2.02	**
Third bedroom	0.145	0.049	2.98	***
Fourth bedroom	0.112	0.052	2.16	**
More than one bathroom	0.05	0.024	2.08	**
Wald chi2(22)	1941.28	***		
Log restricted-likelihood	66.196811	***		
Ward premium	0.1540789	0.0337397		
LR test vs. linear regression:	120.07	***		
Observations	460			
Groups (wards)	13			

Note: *** denotes statistically significant at the 1% level; ** at the 5% level; and * at the 10% level

Eastleigh house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.755	0.022	524.62	***
2003 premium	0.122	0.011	11.48	***
2004 premium	0.202	0.011	18.11	***
2005 premium	0.225	0.011	20.06	***
2006 premium	0.248	0.01	25.21	***
2007 premium	0.339	0.01	33.48	***
Square feet	0.0003642	0.0000163	22.28	***
Built before 1981	-0.052	0.009	-5.8	***
Built before 1991	-0.023	0.009	-2.64	***
New-build	0.117	0.023	4.99	***
Double garage	0.066	0.013	4.93	***
Detached	0.161	0.01	16.51	***
Terraced	-0.065	0.009	-7.59	***
Detached bungalow	0.26	0.016	16.23	***
Semi-detached bungalow	0.063	0.029	2.13	**
Flat	-0.204	0.018	-11.57	***
Converted flat	-0.15	0.021	-7.1	***
Leasehold	-0.081	0.03	-2.69	***
Second bedroom	0.116	0.015	7.69	***
Third bedroom	0.155	0.017	8.9	***
Fourth bedroom	0.209	0.023	9.24	***
Fifth bedroom	0.21	0.033	6.43	***
More than one bathroom	0.027	0.008	3.28	***
Wald chi2(22)	10723.47	***		
Log restricted-likelihood	1014.4006	***		
Ward premium	0.0540767	0.0096691		
LR test vs. linear regression:	190.43	***		
Observations	1546			
Groups (wards)	19			

Leeds house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.374	0.04	281.04	***
2003 premium	0.194	0.012	16.38	***
2004 premium	0.36	0.013	28.67	***
2005 premium	0.426	0.013	33.07	***
2006 premium	0.472	0.011	44.56	***
2007 premium	0.532	0.011	49.78	***
Square feet	0.0004468	0.0000209	21.37	***
Square feet2	-3.56E-08	1.75E-08	-2.04	**
Built before 1971	-0.138	0.012	-11.95	***
Built before 1981	-0.104	0.016	-6.69	***
Built before 1991	-0.063	0.016	-3.99	***
No central heating	-0.133	0.012	-11.03	***
Partial central heating	-0.073	0.022	-3.29	***
Single garage	0.078	0.008	9.83	***
Double garage	0.212	0.019	10.96	***
Detached	0.112	0.012	9.75	***
Terraced	-0.092	0.008	-10.91	***
Detached bungalow	0.285	0.035	8.07	***
Semi-detached bungalow	0.133	0.026	5.11	***
Flat	-0.073	0.02	-3.63	***
Converted flat	0.054	0.023	2.37	**
Second bedroom	0.094	0.02	4.72	***
Third bedroom	0.148	0.022	6.68	***
Fourth bedroom	0.212	0.026	8.15	***
Fifth bedroom	0.268	0.035	7.61	***
More than one bathroom	0.023	0.009	2.48	**
Wald chi2(22)	11091.99	***		
Log restricted-likelihood	635.38199	***		
Ward premium	0.1769297	0.022588		
LR test vs. linear regression:	1449.42	***		
Observations	3665			
Groups (wards)	33			

Leicester house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.267	0.048	236.46	***
2003 premium	0.269	0.015	17.57	***
2004 premium	0.471	0.017	27.83	***
2005 premium	0.496	0.017	28.63	***
2006 premium	0.509	0.015	34.74	***
2007 premium	0.561	0.014	39.17	***
Square feet	0.0005815	0.0000327	17.8	***
Square feet2	-5.80E-08	2.74E-08	-2.12	**
Built before 1971	-0.107	0.017	-6.43	***
Built before 1981	-0.146	0.023	-6.35	***
New-build	0.183	0.038	4.78	***
No central heating	-0.057	0.025	-2.26	**
Single garage	0.058	0.012	4.77	***
Double garage	0.091	0.036	2.49	**
Detached	0.116	0.02	5.75	***
Terraced	-0.119	0.012	-9.6	***
Detached bungalow	0.201	0.041	4.88	***
Flat	-0.226	0.028	-8.1	***
Converted flat	-0.151	0.037	-4.05	***
Leasehold	-0.155	0.058	-2.67	***
Second bedroom	0.084	0.031	2.74	***
Third bedroom	0.099	0.035	2.85	***
Fourth bedroom	0.135	0.044	3.11	***
Fifth bedroom	0.154	0.056	2.74	***
Wald chi2(22)	5796.54	***		
Log restricted-likelihood	375.1886	***		
Ward premium	0.1299073	0.0206818		
LR test vs. linear regression:	536.71	***		
Observations	1295			
Groups (wards)	22			

North Tyneside house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.191	0.048	231.21	***
2003 premium	0.279	0.016	17.66	***
2004 premium	0.495	0.017	28.73	***
2005 premium	0.582	0.018	32.93	***
2006 premium	0.597	0.015	40.72	***
2007 premium	0.63	0.015	43.21	***
Square feet	0.0004687	0.0000212	22.1	***
Built before 1971	-0.213	0.016	-13.62	***
Built before 1981	-0.176	0.024	-7.43	***
Built before 1991	-0.085	0.024	-3.49	***
New-build	0.067	0.041	1.64	
No central heating	-0.144	0.024	-6.1	***
Single garage	0.131	0.011	11.39	***
Double garage	0.187	0.026	7.24	***
Detached	0.079	0.02	4.06	***
Terraced	-0.106	0.013	-8.41	***
Detached bungalow	0.263	0.062	4.24	***
Semi-detached bungalow	0.183	0.034	5.35	***
Flat	-0.237	0.019	-12.74	***
Converted flat	-0.182	0.022	-8.13	***
Leasehold	0.036	0.018	1.94	*
Second bedroom	0.134	0.024	5.71	***
Third bedroom	0.183	0.025	7.28	***
Fourth bedroom	0.186	0.031	6.02	***
Fifth bedroom	0.145	0.043	3.35	***
Wald chi2(22)	7371.78	***		
Log restricted-likelihood	295.22632	***		
Ward premium	0.1717323	0.028408		
LR test vs. linear regression:	736.96	***		
Observations	1742			
Groups (wards)	20			

Southampton house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.766	0.03	390.04	***
2003 premium	0.156	0.011	13.84	***
2004 premium	0.257	0.011	23.17	***
2005 premium	0.251	0.012	21.33	***
2006 premium	0.305	0.01	30.42	***
2007 premium	0.37	0.01	36.01	***
Square feet	0.0004956	0.0000215	23.05	***
Square feet2	-4.64E-08	2.05E-08	-2.26	**
Built before 1971	-0.161	0.012	-13.34	***
Built before 1981	-0.145	0.018	-8.1	***
Built before 1991	-0.067	0.015	-4.47	***
No central heating	-0.058	0.012	-4.79	***
Partial central heating	-0.039	0.011	-3.39	***
Single garage	0.056	0.007	7.56	***
Double garage	0.077	0.031	2.47	**
Detached	0.106	0.011	9.71	***
Terraced	-0.074	0.008	-8.79	***
Detached bungalow	0.227	0.022	10.16	***
Flat	-0.169	0.013	-12.73	***
Converted flat	-0.126	0.015	-8.16	***
Second bedroom	0.099	0.015	6.67	***
Third bedroom	0.127	0.019	6.68	***
Fourth bedroom	0.196	0.025	7.77	***
Fifth bedroom	0.194	0.045	4.26	***
More than one bathroom	0.026	0.008	3.14	***
Wald chi2(22)	9333.24	***		
Log restricted-likelihood	1000.8822	***		
Ward premium	0.0820197	0.0155144		
LR test vs. linear regression:	364.79	***		
Observations	2057			
Groups (wards)	16			

Suffolk Coastal house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.444	0.043	267.13	***
2003 premium	0.13	0.018	7.12	***
2004 premium	0.283	0.019	14.76	***
2005 premium	0.299	0.02	14.68	***
2006 premium	0.348	0.019	18.53	***
2007 premium	0.428	0.019	22.78	***
Square feet	0.0004573	0.0000233	19.62	***
Built before 1971	0.053	0.014	3.91	***
No central heating	-0.064	0.027	-2.4	**
Partial central heating	-0.048	0.019	-2.47	**
Single garage	0.061	0.014	4.44	***
Double garage	0.121	0.024	5.11	***
Detached	0.134	0.016	8.18	***
Terraced	-0.048	0.017	-2.86	***
Detached bungalow	0.184	0.024	7.8	***
Flat	-0.135	0.041	-3.27	***
Converted flat	-0.161	0.042	-3.87	***
Leasehold	-0.273	0.121	-2.25	**
Second bedroom	0.14	0.032	4.39	***
Third bedroom	0.176	0.034	5.19	***
Fourth bedroom	0.202	0.038	5.24	***
Fifth bedroom	0.203	0.049	4.13	***
More than one bathroom	0.044	0.014	3.14	***
Wald chi2(22)	4451.95	***		
Log restricted-likelihood	255.09188	***		
Ward premium	0.1193392	0.016462		
LR test vs. linear regression:	220.65	***		
Observations	996			
Groups (wards)	34			

Swindon house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	11.568	0.035	334.53	***
2003 premium	0.078	0.008	9.29	***
2004 premium	0.154	0.008	18.16	***
2005 premium	0.173	0.009	19.97	***
2006 premium	0.23	0.008	29.47	***
2007 premium	0.288	0.008	34.88	***
Square feet	0.000296	0.0000179	16.53	***
Square feet2	4.07E-08	1.36E-08	3	***
Built before 1971	-0.043	0.009	-4.77	***
Built before 1981	-0.055	0.01	-5.45	***
Built before 1991	-0.024	0.01	-2.48	**
New-build	0.054	0.017	3.15	***
No central heating	-0.062	0.012	-4.95	***
Partial central heating	-0.07	0.012	-5.91	***
Single garage	0.025	0.006	4.3	***
Double garage	0.133	0.012	11.32	***
Detached	0.107	0.008	13.6	***
Terraced	-0.078	0.007	-11.9	***
Detached bungalow	0.209	0.021	9.8	***
Semi-detached bungalow	0.093	0.02	4.75	***
Flat	-0.179	0.017	-10.29	***
Converted flat	-0.177	0.027	-6.5	***
Second bedroom	0.135	0.016	8.65	***
Third bedroom	0.221	0.018	12.36	***
Fourth bedroom	0.302	0.021	14.32	***
Fifth bedroom	0.285	0.028	10.3	***
Wald chi2(22)	12724.06	***		
Log restricted-likelihood	1662.7002	***		
Ward premium	0.1309938	0.0206804		
LR test vs. linear regression:	970.53	***		
Observations	2574			
Groups (wards)	22			

Wigan house price model estimation results

Variable	Coefficient	Standard error	z statistic	
Constant	10.939	0.054	203.56	***
2003 premium	0.205	0.012	17.75	***
2004 premium	0.46	0.014	33.94	***
2005 premium	0.551	0.015	37.62	***
2006 premium	0.605	0.012	49.48	***
2007 premium	0.659	0.012	53.55	***
Square feet	0.0004858	0.0000201	24.12	***
Built before 1971	-0.158	0.013	-12.57	***
Built before 1981	-0.092	0.016	-5.85	***
Built before 1991	-0.046	0.016	-2.85	***
New-build	0.077	0.022	3.55	***
No central heating	-0.136	0.022	-6.21	***
Partial central heating	-0.05	0.019	-2.59	**
Single garage	0.118	0.009	12.71	***
Double garage	0.168	0.022	7.59	***
Detached	0.125	0.013	9.43	***
Terraced	-0.17	0.011	-15.26	***
Detached bungalow	0.277	0.032	8.65	***
Semi-detached bungalow	0.098	0.022	4.45	***
Flat	-0.105	0.041	-2.57	**
Leasehold	0.032	0.008	3.97	***
Second bedroom	0.162	0.045	3.64	***
Third bedroom	0.24	0.045	5.29	***
Fourth bedroom	0.29	0.049	5.9	***
Fifth bedroom	0.238	0.067	3.54	***
Wald chi2(22)	11024.18	***		
Log restricted-likelihood	462.84335	***		
Ward premium	0.1292995	0.0196166		
LR test vs. linear regression:	673.74	***		
Observations	2531			
Groups (wards)	24			

Appendix 5: Predicting Development Viability

Chapter 5 (Table 9) sets out the results of the development viability model estimation. These can be used to predict the viability for a given site. This is done by combining the known values of variables with model estimates or coefficients.

For example, the following table summarises the important variables for brownfield sites in 2005 in North Tyneside.

Variable	Value for the least deprived neighbourhood	Value for the typical neighbourhood	Value for the most deprived neighbourhood
Private completions per 1000 households	7.12	7.12	7.12
Lower quartile house prices to earnings	6.23	6.23	6.23
Interest rates (average for 2005)	3.68	3.68	3.68
Total outstanding planning consents per 1000 households	6.77	6.77	6.77
Units (assume a 15 unit site)	15	15	15
Units^2	625	625	625
IMD score	3.75	24.84	63.14
North Tyneside sum of greenfield supply ÷ distance	0.030095	0.030095	0.030095
North Tyneside sum of brownfield supply ÷ distance	0.142353	0.142353	0.142353

The corresponding coefficients from Table 9 in the main report are reproduced below:

Variable	Value for the least deprived neighbourhood
Constant	0.635471
Private completions per 1000 households	-0.00742
Lower quartile house prices to earnings	0.059706
Interest rates	-0.28886
Total outstanding planning consents per 1000 households	-0.01201
Units	0.041667
Units^2	-0.00015
IMD score	-0.00412
North Tyneside sum of greenfield supply ÷ distance	-2.93116
North Tyneside sum of brownfield supply ÷ distance	-0.38935

In order to predict viability, the variables are simply multiplied by the coefficients and a running total is calculated. For example, for a brownfield site in the least deprived neighbourhood in North Tyneside in 2005, the calculation is as follows:

Natural log of viability = 0.635471 + (-0.00742 × 7.12) + (0.059706 × 6.23)
+ (-0.28886 × 3.68) + (-0.01201 × 6.77)
+ (0.041667 × 15) + (-0.00015 × 625)
+ (-0.00412 × 3.75) + (-2.93116 × 0.030095)
+ (-0.38935 × 0.142353)

= 0.2411

When the anti-log (exponential) of this value is calculated, this translates to a predicted viability index of 1.2763, ignoring rounding differences in this example.[3]

This means that the development has a predicted value 27.63% higher than predicted construction costs. This residual logically represents the amount available for land acquisition and developer's profit.

Following this process, the viability of all three sites shown in the first table in this appendix can be estimated as follows:

15 unit brownfield site in the least deprived neighbourhood	1.2763
15 unit brownfield site in the typical neighbourhood	1.1660
15 unit brownfield site in the most deprived neighbourhood	0.9961 (i.e. not viable)

[3] There may be small rounding differences between the final figures shown, and the example calculation.